Appendix A Record of Minister's Opinion

NSW GOVERNMENT
Department of Planning

28 May 2008

Contact: Dinuka McKenzie
Phone: 02 9228 6348
Fax: 02 9228 6355
Email: dinuka.mckenzie@planning.nsw.gov.au

Mr John Whaley
Commercial Manager
Lucas Energy
Level 8, 160 Queen Street
MELBOURNE VIC 3000

Dear Mr Whaley

Proposed Gloucester Coal Bed Methane Development Project

Please be advised that on 21 May 2008, the Director-General of the Department of Planning, under delegation from the Minister for Planning, formed the opinion under clause 6 of the *State Environmental Planning Policy (Major Projects) 2005* (Major Project SEPP) that the abovementioned project is development of a kind that is described in Schedule 1 of the Major Project SEPP.

The project is therefore declared to be a Major Project under Part 3A of the *Environmental Planning and Assessment Act 1979* and will be subject to determination by the Minister for Planning. I have enclosed a copy of the record of the Director-General's opinion for your information and reference.

Please do not hesitate to contact me on the above details should you wish to discuss or clarify this matter.

Yours sincerely

Dinuka McKenzie
A/ Senior Planner – Water and Energy
Major Infrastructure Assessments

NSW GOVERNMENT
Department of Planning

Record of Minister's opinion for the purposes of Clause 6(1) of the State Environmental Planning Policy (Major Projects) 2005

I, the Director-General of the Department of Planning, as delegate of the Minister for Planning under delegation executed on 31 October 2005, have formed the opinion that the development described in the Schedule below, is development of a kind that is described in Schedule 1 of the State *Environmental Planning Policy (Major Projects) 2005* – namely clause 26A "Development for the purposes of a pipeline in respect of which a licence is required under the *Pipelines Act 1967*", and is thus declared to be a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies for the purpose of section 75B of that Act.

Schedule

A proposal to establish and operate the Gloucester Coal Bed Methane Development Project, including: a gas transmission line from near Stratford to near Hexham; central processing facilities including compression near Stratford; and field development within PEL 285 principally comprising wells and gathering lines.

SH Haddad

Sam Haddad
Director-General

Date: 21/5/2008.

Appendix B Authorisation of Concept Plan

NSW GOVERNMENT
Department of Planning

Record of Minister's authorisation of a Concept Plan under section 75M(1) of the Environmental Planning and Assessment Act 1979

I, the Minister for Planning, authorise the submission of a Concept Plan for the development described in the Schedule below.

Schedule

The proposed construction and operation of the Gloucester Coal Seam Gas project involving the extraction, compression and piping of high pressure gas from approximately Stratford to Hexham in the Gloucester, Greater Lakes, Dungog, Port Stephens, Maitland and Newcastle local government areas, generally as described in the document titled "*Gloucester Coal Seam Gas Project Concept Plan and Preliminary Assessment Report*" dated June 2008 and prepared by GHD Pty Ltd for the Lucas Energy and Molopo Australia Joint Venture.

Frank Sartor
Minister for Planning

Date: 4/8/08

Appendix C Environmental Assessment Requirements

NSW GOVERNMENT
Department of Planning

Contact: Dinuka McKenzie
Phone: (02) 9228 6348
Fax: (02) 9228 6355
Email: Dinuka.McKenzie@planning.nsw.gov.au

Our ref: S08/00826
Your ref:

Mr Stuart Galway
Land and Approvals Manager
Lucas/ Molopo Joint Venture
22 Tate Street
GLOUCESTER NSW 2422

Dear Mr Galway

Proposed Gloucester Coal Seam Gas Project (MP08_0154), Multiple Local Government Areas

The Department has received your major project application for the Gloucester Coal Seam Gas Project, which comprises:

- a concept plan application for:
  - gas wells and gathering lines within a Field Area;
  - a Central Processing Facility; and
  - an approximately 1 kilometre width pipeline corridor between Stratford and Hexham; and
- concurrent project applications for:
  - 60-90 gas wells and gathering lines within a sub-area of the total concept plan Field Area;
  - the Central Processing Facility; and
  - an approximately 100 metre wide pipeline corridor within the 1 kilometre width concept plan pipeline corridor, between Stratford and Hexham.

I wish to advise that on the 4 August 2008, the Acting Minister for Planning, the Hon. John Hatzistergos, authorised the submission of a concept plan for the Gloucester Coal Seam Gas Project in accordance with section 75M(1) of the *Environmental Planning and Assessment Act 1979* (the Act). A copy of the concept plan authorisation is enclosed for your information.

I have also attached a copy of the Director-General's requirements (DGRs) for the preparation of an Environmental Assessment for the concept plan and the part project applications. These requirements have been prepared following the Planning Focus Meeting held on Monday 21 July 2008 and in consultation with the relevant government agencies.

It should be noted that the Director-General's requirements have been prepared based on the information provided to date. Under section 75F(3) of the Act, the Director-General may alter or supplement these requirements if necessary and in light of any additional information that may be provided prior to the proponent seeking approval for the Project.

Given the scale of the proposal, the Director-General's requirements have been drafted with a particular focus on a tiered assessment of impacts. With respect to each relevant impact, the Environmental Assessment should present a considered screening of potential impacts along the length of the proposal, to identify areas of potentially significant impact for further, more detailed assessment. Sufficient information must be provided in the Environmental Assessment to demonstrate the likely impacts and acceptability of the proposal at a concept plan and project level, (depending of the proposal component). In addition to the assessment of the areas of potentially significant impact, other areas along the length of the proposal should be assessed in a more general manner, with a particular focus on the development of frameworks for the mitigation, management and monitoring of more minor and generic environmental issues. The Environmental Assessment must be prepared using valid and accepted technical and scientific tools and

methodologies, focussing on key environmental impacts and robust mitigation measures to address potential impacts from the proposal.

I would appreciate it if you could contact the Department at least two weeks before you propose to submit the Environmental Assessment for the proposal to determine:

- the fees applicable to the application;
- relevant land owner notification requirements;
- consultation and public exhibition arrangements that will apply;
- options available in publishing the Environmental Assessment via the Internet; and
- number and format (hard-copy or CD-ROM) of the Environmental Assessment that will be required.

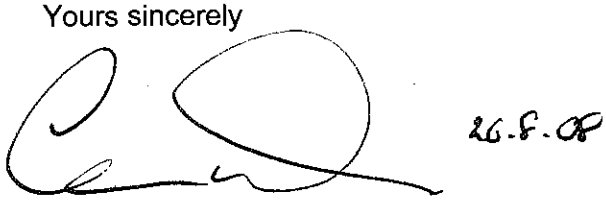
Prior to exhibiting the Environmental Assessment, the Department will review the document to determine if it adequately addresses the DGRs. The Department may consult with other relevant government agencies in making this decision. If the Director-General considers that the Environmental Assessment does not adequately address the DGRs, the Director-General may require the Proponent to revise the Environmental Assessment to address the matters notified to the Proponent. Following this review period the Environmental Assessment will be made publicly available for a minimum period of 30 days.

If your proposal includes any actions that could have a significant impact on matters of National Environmental Significance, it will require an additional approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval would be in addition to any approvals required under NSW legislation and it is your responsibility to contact the Department of the Environment, Heritage, Water and the Arts to determine if an approval under the EPBC Act is required for your proposal (6274 1111 or http://www.environment.gov.au).

Please note that the Commonwealth Government has accredited the NSW environmental assessment process for assessing impacts on matters of National Environmental Significance. As a result, if it is determined that an approval is required under the EPBC Act, please contact the Department immediately as supplementary Director-General's requirements will need to be issued.

If you have any enquiries about these requirements, please contact Ms Dinuka McKenzie, Senior Environmental Planning Officer, Major Infrastructure Assessments on 02 9228 6348 or via email (dinuka.mckenzie@planning.nsw.gov.au).

Yours sincerely



26.8.08

Chris Wilson
Executive Director
as delegate for the Director-General

Director-General's Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Concept Plan	Construction and operation of the Gloucester Coal Seam Gas Project, comprising:
	• a concept plan application for:
	  o gas wells and gathering lines within a Field Area;
	  o a Central Processing Facility; and
	  o an approximately 1 kilometre width pipeline corridor between Stratford and Hexham; and
	• concurrent project applications for:
	  o 60-90 gas wells and gathering lines within a sub-area of the total concept plan Field Area;
	  o the Central Processing Facility; and
	  o an approximately 100 metre wide pipeline corridor within the 1 kilometre width concept plan pipeline corridor, between Stratford and Hexham.

Site	Land required for the proposal generally between Stratford and Hexham in the Gloucester Shire, Great Lakes Shire, Dungog Shire, Port Stephens, Maitland City, and Newcastle City local government areas.
Proponent	Lucas/ Molopo Joint Venture
Date of Issue	26 August 2008
Date of Expiration	26 August 2010

General Requirements	The Environmental Assessment (EA) must include:
	• an **executive summary**;
	• a **description** of the concept plan and the part projects at an appropriate level of detail, including:
	  o an outline of the overall concept plan development including potential phasing of future stages; and
	  o construction and operation details for the part projects including potential operational and construction staging.
	• consideration of **relevant statutory provisions** for the concept plan and part projects including consistency with the objects (section 5) of the *Environmental Planning and Assessment Act 1979*;
	• an **assessment of the key issues** specified below for the concept plan and part projects considering construction and operational impacts and cumulative impacts, as relevant;
	• a **draft Statement of Commitments** outlining further investigation/ design considerations for the concept plan; and environmental management, mitigation, offset and/ or monitoring measures for the part projects, clearly identifying any measures which would apply across all three of the projects.
	• a **conclusion justifying** the concept plan as a whole and each of the part projects taking into consideration their environmental, social and economic impacts; the suitability of the site; and the public interest; and
	• **certification** by the author of the EA that the information contained in the assessment is neither false nor misleading.

Key Assessment Requirements	The EA must include an assessment of the following key issues: • **Strategic Planning and Justification** – the EA must include a strategic assessment of the need, scale, scope and location of the concept plan as a whole and its component projects, considering the availability and location of gas reserves, areas of gas demand and expected demand growth, and pipeline network constraints. The assessment must describe alternatives considered (location and/ or design) and provide justification for the preferred proposal demonstrating how it achieves the stated objectives of the concept plan and part projects. The EA must clearly demonstrate the benefits of the concept plan and the part projects at a strategic and local scale. • **Landuse and Infrastructure** – the EA must include a justified and tiered assessment of impacts to landuse and infrastructure including: o an assessment of the impacts of the proposal on directly affected land and on surrounding landuse (including on mineral reserves, conservation areas, land of

high agricultural value and land of significant scenic or visual value) considering: local and strategic landuse objectives, impacts on future development potential, land severance and sterilisation impacts, and any development pressures and/ or economic opportunity that may be supported or generated as a result of the proposal in the surrounding area. The EA must identify the likely post-activity landuse and the rehabilitation/ decommissioning measures that will be implemented to achieve this; and
- identification of major infrastructure (including rail, road, electricity, gas and water supply infrastructure) that may be impacted by the proposal including how the infrastructure would be traversed (where relevant) and options for mitigating and managing conflicts between the project and infrastructure (including traffic disruptions, alternative access arrangements etc).

- **Flora and Fauna Impacts** – the EA must include a justified and tiered assessment of impacts on biodiversity including on aquatic and riparian habitat values and threatened species and communities listed under both State and Commonwealth legislation, including:
  - a review of bioregions that will be or may be impacted by the proposal across its length;
  - for each identified bioregion, include a screening of species, populations, ecological communities and habitats based on ecological significance and the potential for impact as a consequence of the proposal;
  - for species, populations, ecological communities and habitats with high ecological significance and significant potential for impact, include sufficient information to demonstrate the likely impacts and their acceptability, consistent with *Guidelines for Threatened Species Assessment* (DEC, July 2005);
  - an outline of any proposed compensatory habitat or off-set strategy, including scale, scope and timing of implementation, considering region-based ecological outcomes, including habitat connectivity and distribution of species; and
  - demonstrating a design philosophy of impact avoidance on ecological values, and in particular, ecological values of high significance.

- **Indigenous and Non-Indigenous Heritage** – the EA must include a justified and tiered assessment of impacts to indigenous and non-indigenous heritage, including:
  - sufficient information to demonstrate the likely impacts of the proposal on indigenous heritage values (archaeological and cultural), consistent with *Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation* (DEC, July 2005) including measures to avoid, minimise, manage and/ or offset impacts. The EA must demonstrate effective consultation with indigenous stakeholders in determining impacts and developing mitigation options; and
  - sufficient information to demonstrate the likely impacts of the proposal on non-indigenous heritage values (including heritage vistas) consistent with the guidelines in the *NSW Heritage Manual*. Where impacts to State or local non-indigenous heritage items are proposed, a statement of heritage significance must be included and measures identified to mitigate and mange impacts.

- **Surface and Groundwater** – the EA must include a justified and tiered assessment of impacts on surface and groundwater, including:
  - quantification of the coal seam groundwater volumes likely to be require extraction as part of the Field Area (including future stages of the concept plan) and an assessment of the impact of that extraction on existing groundwater resources and users, including measures to monitor and mitigate impacts, as necessary;
  - identification of how extracted water would be stored, used, disposed of and/ or re-supplied to other users at the Central Processing Facility;
  - identification of watercourses to be traversed by the proposal or otherwise impacted by activities within the riparian corridor and an assessment of how the hydrology, water quality, aquatic habitat and riparian vegetation of the watercourses would be protected during the construction and operation of the proposal; and
  - an assessment of erosion and sedimentation risk associated with the proposal, particularly in areas of acid sulphate soils and measures to contain and manage impacts.

- **Noise and Vibration** – the EA must include a justified and tiered assessment of the noise and vibration risks associated with the proposal including an operational noise

	impact assessment of the Central Processing Facility project consistent with *NSW Industrial Noise Policy* (EPA, 2000) and an assessment of construction noise and vibration impacts (including of construction traffic noise and blasting impacts, where relevant) considering measures to mitigate, manage and monitor impacts. • **Traffic and Transport** – the EA must include a justified and tiered assessment of the construction and operational traffic impacts of the proposal including identification of construction haulage routes, assessment of any significant construction disruptions to road traffic or access (and associated control measures, including alternative access arrangements, and road upgrade requirements for operational access and/or construction traffic (e.g. over-size haulage). • **Hazards and Risk Impacts –** the EA must include a screening of potential hazards likely to be associated with the proposal to determine the potential for off site impacts and any requirement for a Preliminary Hazard Analysis (PHA), consistent with the approach outlined in Department's *Hazardous Industry Planning Advisory Paper No. 3, Hazardous Industry Planning Advisory Paper No. 6* and *Multi-level Risk Assessment*, and with reference to applicable Australian Standards (including *AS2885 Pipelines - Gas and Liquid Petroleum – Operation and Maintenance*). Risk impacts associated with the transport of dangerous goods and hazardous materials must be documented with reference to the Department's draft *Route Selection* guideline. The EA must specifically consider on-going maintenance and safety management of the proposal, including of bush fire risk. • **Air Quality and Greenhouse Gases** – the EA must include a justified and tiered assessment of the risk of fugitive dust, odour and flare impacts during the construction and operation of the part projects and identify measures to mitigate impacts. The EA must also include a quantitative greenhouse gas assessment of the proposal. Emission levels must be expressed on the basis of tonnes per unit of production, total annual emissions and total emissions during the project life, and as a percentage of total annual NSW and national emissions. If a greenhouse gas offset is proposed, full details of this offset(s) must be included in the EA. • **General Environmental Risk Analysis** – notwithstanding the above key assessment requirements, the EA must include an environmental risk analysis to identify potential environmental impacts associated with the proposal (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the EA.
Consultation Requirements	You must undertake an appropriate and justified level of consultation with relevant government authorities, service providers, and stakeholders during the preparation of the EA, including (but not necessarily limited to): • NSW Department of Environment and Climate Change; • NSW Department of Water and Energy; • NSW Department of Primary Industries; • NSW Roads and Traffic Authority; • NSW Rural Fire Service; • Australian Rail Track Corporation; • Gloucester Shire Council; • Great Lakes Shire Council; • Dungog Shire Council; • Port Stephens Council; • Maitland City Council; • Newcastle City Council; and • the local community and land owners. The EA must clearly indicate issues raised by stakeholders during consultation, and how those matters have been addressed in the EA.

NSW GOVERNMENT
Department of Planning

Contact: Dinuka McKenzie
Phone: (02) 9228 6348
Fax: (02) 9228 6355
Email: Dinuka.McKenzie@planning.nsw.gov.au

Our ref: S08/00826
Your ref:

Ms Ruth Baker
Principal Environmental Consultant
AECOM
PO Box 726
PYMBLE NSW 2073

Dear Ms Baker

Gloucester Gas Project – Supplementary Director-General's Requirements

I refer to your letter on behalf of AGL Gloucester Pty Ltd (the Proponent) dated 11 August 2009 identifying changes to the Gloucester Gas Project for which concept plan and concurrent project approval is being sought. The changes involve:

- the inclusion of an alternative location for the construction of the Central Processing Facility on the basis that only one location would be developed;
- inclusion of a small scale 15 megawatt ancillary power station facility within the footprint of the Central Processing Facility;
- inclusion of a construction workforce camp for drilling activities in the Stage 1 Gas Field Development Area and during the construction of the gas pipeline; and
- minor amendments to the alignment of the gas pipeline corridor.

The Director-General confirms that the environmental assessment requirements issued on 26 August 2008 and 19 October 2008 would apply to the amended project including to the transmission line connection for the ancillary power station facility.

Furthermore, the following additional requirements would apply to the ancillary power station component:

- a comprehensive air quality impact assessment prepared in accordance with the *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* (DEC 2005), with particular focus on nitrogen oxides and particulates. The assessment must consider worst case operating scenarios and meteorological conditions and potential cumulative impacts from surrounding mining operations;
- an assessment of potential operational noise impacts consistent with *NSW Industrial Noise Policy* (EPA, 2000); and
- consideration of potential risks to aviation safety from stack emissions.

You must ensure that the Environmental Assessment adequately addresses the Director-General's requirements issued on 26 August 2008, 19 October 2008 and the requirements identified in this letter.

If you have any enquiries about these requirements, please contact Ms Dinuka McKenzie, Senior Environmental Planning Officer, Major Infrastructure Assessments on 02 9228 6348 or via email (dinuka.mckenzie@planning.nsw.gov.au).

Yours sincerely

25.8.09

Chris Wilson
Executive Director, Major Project Assessments
as delegate for the Director-General

NSW GOVERNMENT
Department of Planning

Contact: Dinuka McKenzie
Phone: (02) 9228 6348
Fax: (02) 9228 6355
Email: Dinuka.McKenzie@planning.nsw.gov.au

Our ref: S08/00826
Your ref:

Mr Stuart Galway
Land and Approvals Manager
Lucas/ Molopo Joint Venture
22 Tate Street
GLOUCESTER NSW 2422

Dear Mr Galway

Gloucester Coal Seam Gas Project - Supplement to the Director-General's Requirements

I refer to the Director-General's requirements issued for the above Project on 26 August 2008.

As you are aware, the project has been declared a Controlled Action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As a result, the Department of Planning, on behalf of the Minister for Planning, has confirmed to the Commonwealth that the Bilateral Agreement between the NSW and Commonwealth Governments will apply. Accordingly, the Department will undertake an environmental impact assessment of the project to satisfy the requirements of both NSW and Commonwealth legislation.

To ensure that sufficient information is provided to enable an appropriate level of assessment of relevant controlling actions, the Director-General has issued supplementary requirements for the Environmental Assessment under section 75F(3) of the *Environmental Planning and Assessment Act 1979*. A copy of the supplementary Director-General's requirements is attached.

You must ensure that the Environmental Assessment adequately addresses the Director-General's requirements issued on 26 August 2008, and the supplementary requirements attached to this letter.

If you have any enquiries about these requirements, please contact Ms Dinuka McKenzie, Senior Environmental Planning Officer, Major Infrastructure Assessments on 02 9228 6348 or via email (dinuka.mckenzie@planning.nsw.gov.au).

Yours sincerely

Chris Wilson
Executive Director
as delegate for the Director-General

A.10.08

Supplementary Director-General's Requirements

Section 75F(3) of the Environmental Planning and Assessment Act 1979

The Gloucester Coal Seam Gas Project (reference: MP08_0154, EPBC 2008/4432) has been declared to be a Controlled Action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The relevant controlling provisions are sections 16 and 17B (wetlands of international importance) and 18 and 18A (listed threatened species and ecological communities) of the EPBC Act.

Under the provisions of the bilateral agreement between New South Wales and the Commonwealth, the environmental impacts of the controlled action will be assessed under Part 3A of the *Environmental Planning & Assessment Act 1979*.

To enable the assessment of impacts on the protected matters/ controlling provisions under the EPBC Act, the Director-General's requirements issued for the project on 26 August 2008 are supplemented with the following additional requirements.

The Environmental Assessment (EA) must include:

- a description of the controlled action;
- a description of the relevant impacts[1] of the controlled action;
- a description of feasible mitigation measures or compensatory measures, changes to the controlled action or procedures, which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts;
- to the extent practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact;
- an assessment of the following matters:
    - all relevant impacts that the controlled action has, will have or is likely to have on the ecological character of the Hunter Estuary Wetlands, a wetland of international importance listed under sections 16 and 17B of the EPBC Act and on any species or ecological communities potentially present and listed under sections 18 and 18A of the EPBC Act; and
    - where Potential Acid Sulphate Soils (PASS) are encountered, include information on the elevation of the affected area, the depth and extent of drilling and proposed methods for soil management; and identify risks and provide details of mitigation measures in relation to impacts from PASS, including impacts on the Hunter Estuary Wetlands listed under sections 16 and 17B of the EPBC Act;
- sufficient information about the controlled action and its relevant impacts to allow an informed decision whether or not to approve the controlled action under the EPBC Act;
- information to address the matters outlined in Schedule 4 of the Commonwealth *Environment Protection and Biodiversity Conservation Regulation 2000*; and
- details of consultation undertaken with the Department of the Environment, Water, Heritage and the Arts during the preparation of the EA clearly indicating the issues raised and how the matters have been addressed in the EA.

The description and assessment of these issues in the Environmental Assessment must be integrated as far as is practicable with the description and assessment of the other flora and fauna impacts of the project. However, a separate stand alone chapter or summary specifically addressing impacts on the relevant protected matters/ controlling provisions under the EPBC Act, together with any commitments or proposed measures to mitigate such impacts, should also be included in the Environmental Assessment.

[1] The term "relevant impact" is defined in section 82 of the EPBC Act.

Appendix D Minutes of Planning Focus Meeting

ENSR Australia Pty Ltd (ENSR) ABN 34 060 204 702
PO Box 726 PYMBLE NSW 2073
T+61 2 8484 8999 F+61 2 8484 8989 www.ensr.com.au

Meeting Minutes

MEETING	**Lucas Energy PFM**
DATE	23 July 2008
TIME	10:30 am
MEETING #	1

PRESENT	Mark Hartwell - DECC Newcastle, Fergus Hancock, DWE Newcastle, Melissa Thomas - Port Stevens Council, Steve Cousins, DPI, Glen Wilcox - Gloucester Council, Paul Bilston - GM Lucas, Ned Osbourne, Alan Borden, Dungog Council, Michael England - ENSR Aust, Ruth Kelly - ENSR Aust
APOLOGIES	Nil
CC	Nil
CHAIR/TEAM LEADER	Stuart Galway – Lucas Energy
MINUTES	Ruth Kelly

ISSUE/QUERY	ACTION/RESPONSE
What is the longevity of the wells?	15yr life project up to 25yrs pipeline 80yr life. 15-20 yrs, 7-10 yrs depending on gas
Clarify approval pathway and the staging of well fields	Noted for inclusion in the EA
When anticipate PPL timing	Same as major project applications
Need to talk to RTA & Rail to confirm use of easements	Yes, initial contact made
Interaction with other infrastructure and utilities easements	Spoken to Country Energy and Transgrid
Consulting with DEWHA	Not yet but likely referral same time as finalisation of Preliminary Environmental Assessment (PEA) submitted to Department of Planning.
When would the PEA be submitted	1 to 2 weeks after the Planning Focus Meeting
How long wells there before spread contracts? 10-12 days permissibility	
Would there be flaring at night – there is current flaring in relation to the Stratford Pilot Project – does that generate any light pollution?	No - only a low glow from 2 small points as the flares at the Stratford Pilot Project are all enclosed.
What is the Ph in dams	8+
What are the well pad sizes?	Predominantly 60 x 60 or 90 x 90 m when constructed but then contracts after construction to a much smaller size
How much water is expected to be generated from the wells	Using the Stratford Pilot Project as a guide, 80,000 L/day each day each well was expected – resulted in 10-15,000 L/day in actuality

ISSUE/QUERY	ACTION/RESPONSE
Port St.	
1. Notification / consultation regarding use of utilities easements 2. Koalas	Noted for inclusion in EA process
Gloucester	
1. Noise CPF immersion layers (given background lower) 2. On site water management 3. Site access heavy equipment and impacts on roads 4. Habitats 5. Gas/Coal exploration balance in context of long term plan. Similarly overall future development of valley and potential conflicting land uses	Noted for inclusion in EA process
DWE	
1. Compliance for construction & design 2. CEMP compliance 3. Safe operation	Noted for inclusion in EA process
DPI	
1. Agricultural & Fisheries input required from DPI 2. Safety to be addressed including wells & lines 3. Competing resources issues (i.e. coal v gas – DPI noted no objections based on coal resource stabilisation) 4. Pipeline on underlaying coal resources 5. Plan well locations from existing mine plans	Noted for inclusion in EA process
GR Lakes	
1. Justification for pipeline project – power, domestic or commercial quantity 2. Landscape scarring 3. Threatened species & European heritage	Noted for inclusion in EA process
DECC	
1. Aboriginal Heritage 2. Threatened species 3. DECC estate lands – Reserves etc 4. Operational and construction noise 5. Waste Water disposed incl. from RO Plant 6. Approvals & permits	Noted for inclusion in EA process
DUNGOG	
1. Pipeline potential to cause sterilisation of areas 2. Road crossings – how impact on smaller rural roads 3. Impacts from other traffic including equipment deliveries. 4. Socio-economic- what benefits? 5. Potential impacts to water resources	Noted for inclusion in EA process

ISSUE/QUERY	ACTION/RESPONSE
DOP	
1. Approvals pathway clarity 2. Road & rail agency consultation timeframe 3. Commonwealth referral – advise DoP of outcomes 4. Clear maps 5. Hazard & Risk assessment	Noted for inclusion in EA process

Appendix E Legal Description of Affected Land

Proposed Pipeline - Rev E				
Lot / DP				
41DP979859	1DP1103426	2DP95008	1DP602809	1DP135852
2DP556576	2DP1103426	1DP197383	21DP815759	342DP828134
1DP531023	3DP1127503	2DP1035953	3DP602809	341DP828134
392DP876813	1DP779047	1DP1035953	1DP797219	35DP197
391DP876813	4DP838079	28DP753176	100DP103983	36DP197
371DP832477	53DP873919	29DP753176	151DP106798	371DP825895
1DP1003762	469DP95667	11DP733189	153DP106798	11ADP197
2DP1003762	37DP95642	12DP733189	3DP240033	9ADP197
522DP95600	19DP998668	2DP598006	1DP240033	7ADP197
417DP753173	18DP998668	1DP450100	3DP1083911	5ADP197
2DP874695	17DP998668	3DP450100	36DP753216	202DP101421
1DP874695	397DP95663	4412DP10313	7DP753216	201DP101421
525DP730328	75DP95643	5DP528432	51DP1110531	29DP738403
5DP1107168	293DP95643	6DP528432	3940DP11293	28DP738403
7DP846843	371DP95658	891DP262981	503DP101839 9	25DP738403
6DP846843	3000DP11263	892DP262981	502DP101839	6DP262053
2DP829617	3001DP11263	893DP262981	7DP708057	1DP803276
2411DP11251	667DP95671	894DP262981	58DP752487	12DP263500
6DP1107984	51DP1128500	895DP262981	2DP823760	13DP263500
1DP1010435	9DP95639	896DP262981	2DP737844	12DP32585
100DP108387	682DP95639	69DP753176	1DP823760	102DP103866
101DP108387	681DP95674	70DP753176	1DP1006516	42DP558481
11DP1116119	676DP111416	68DP753176	2DP1006516	143DP605461
12DP31955	2DP744888	760DP105028	3DP1006516	142DP605461
700DP95757	3DP744888	10DP1040379	25DP1101305	1DP90824
5DP95686	43DP858015	390DP884370	26DP1101305	2DP598846
1DP803291	42DP858015	91DP733137	2DP1053896	2DP813606
7DP803291	41DP858015	104DP730983	105DP104961	1DP813606
5DP803291	102DP557953	2DP248820	201DP107423	3DP813606
6DP803291	24DP95676	3DP248820	4DP1016694	
37DP95775	35DP95407	422DP843104	30DP1109502	
86DP1130905	122DP526671	53DP740432	301DP506711	
8DP803291	14DP505209	1DP702543	2DP1110919	
350DP95778	JDP163593	2DP702543	343DP740220	
17DP746061	16DP95009	3DP702543	1DP598945	
2DP595876	13DP95008	71DP731981	1DP701059	
31DP828026	341DP107564	72DP731981	1DP770353	
32DP828026	14DP95008	185DP111425	11DP242034	
5DP876013	15DP95008	1DP204534	2DP654985	
2DP1043528	27DP95009	1DP705895	2DP197	
325DP95689	2DP1098392	9DP753216	3DP197	
677DP95751	33DP95007	10DP753216	2DP456643	
215DP105395	32DP95007	20DP815759	2DP135852	

Stage 1 Field Area			
Lot / DP			
1 / DP778861	443DP1125089	312DP777579	2DP198813
1 / DP997092	51DP1101295	3DP868581	1DP198813
64 / DP979859	11DP1069458	293DP137520	1DP731725
1 / DP644409	10DP1069458	ADP116326	2DP732788
1 / DP196277	49DP979859	2DP2654993	CDP116337
63 / DP1093998	50DP979859	2DP2279390	DDP116337
62 / DP1093998	51DP979859	1DP998562	390DP1122750
61 / DP979859	772DP826955	7DP722748	25DP753140
60 / DP979859	78DP979859	32DP753140	26DP753140
1DP531023	79DP979859	35DP753140	27DP753140
2DP556576	3DP868581	5DP722748	28DP753140
41DP979859	11DP1015343	392DP1122750	29DP753140
59DP979859	83DP979859	392DP876813	30DP753140
69DP979859	84DP979859	2DP737421	31DP753140
70DP979859	85DP979859	2DP778861	34DP753140
1DP861278	99DP979859	66DP1008585	
1DP241780	7DP822601	36DP753140	
74DP979859	96DP979859	44DP979859	
71DP979859	1DP116336	1DP594237	
58DP979859	2DP732508	881DP8859902	
57DP979859	882DP859902	301DP864518	
72DP979859	2DP1040412	302DP864518	
75DP979859	2DP116336	303DP864518	
73DP979859	3DP116336	304DP864518	
56EDP979859	4DP116336	230DP1110596	
56DDP979859	5DP116336	890DP1134032	
56CDP979859	29DP606093	891DP1134032	
56BDP979859	1DP1040412	2DP868581	
56ADP979859	11DP1112778	1DP868581	
45DP979859	129DP979859	911DP748573	
4DP1062249	26DP1112877	1DP1112778	
3DP1062249	2DP795361	2DP644409	
5DP1062249	272DP731098	3DP644409	
54DP979859	11DP841445	1DP997290	
BDP116316	251DP785579	1DP1004421	
1DP194827	1DP196054	1DP995665	
52DP979859	253DP785579	391DP1122750	
771DP826955	252DP785579	33DP753140	
80DP979859	222DP1061235	7002DP1124382	
1DP198031	1DP1048957	1DP1088094	
1DP718347	1DP195431	2ADP116333	
82DP979859	2DP234517	5DP1074873	
442DP1125089	1DP234517	4DP1074873	

Appendix F Air Quality Assessment

AECOM

Prepared for:

AGL

22 Tate Street
Gloucester NSW 2422





Air Quality Impact Assessment

Proposed Gloucester Gas Project

AECOM

2 November 2009

Document No.: S7003803_FinalAQIA_RPT_2Nov09.doc

Environment

AECOM

Distribution

Air Quality Impact Assessment
Proposed Gloucester Gas Project

2 November 2009

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By
AECOM
ABN: 20 093 846 925
17 Warabrook Boulevarde Warabrook NSW 2304
PO Box 73 Hunter Region MC NSW 2310
Ph: +61 2 4911 4900 Fax: +61 2 4911 4999

for **Holly Marlin**
Senior Environmental Scientist

David Rollings
Associate Chemical Engineer

Technical Peer Reviewer:	**Date:**
	2/11/09
Graham Taylor National Service Line Leader/Senior Principal – Air Quality	

Width of community: <35m wide ; (35-75m) ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 (not linear)
Total community area: Does not extend beyond site; <1ha ; (1-5ha) ; 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	18	50	
Mid	4	5	
Ground	0.2	30 → bare ground 20%	

All woody species present within 50m x 10m plot (plus dominant and throatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
Corymbia citriodora	O	T		18					
E. blakelyi	A	T		18					
E. umbra	D	T		18					
Allocasuarina torulosa	O	T				6			
Melaleuca linariifolius	O	T				6			
Acacia irrorata	O	Sh				4			
Bursaria spinosa	A	Sh					1.5		
Leucopogon juniperinus	F	Sh					1		
Acacia ulicifolia	O	Sh					1		
Ozothamnus diosmifolius	R	Sh					0.6		
Imperata cylindrica	A	G							0.5
Hardenbergia violacea	O	V							
* Senecio madagascariensis	O	H							0.2

(*) KEITH - NSW 69 - HUMER MALLEE DRY SCLEROPHYLL FOREST
(*) CRA - FE 33 - DRY FOOTHILLS SPOTTED GUM

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: FL06 Assessor: JB/GL Date: 30/08/2008

Location: KP 14.3 Creek/riparian veg

GPS Projection: Lat-Long: (UTM) Datum: (GDA94) WGS84; AGD84 Zone: 56

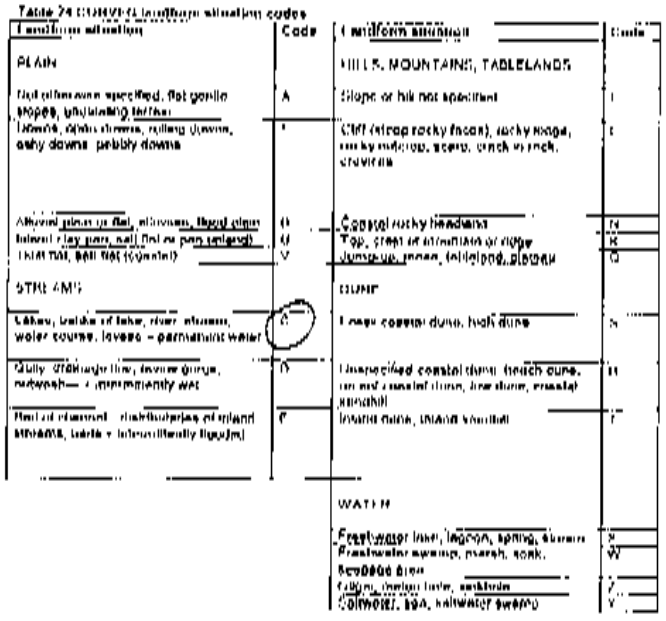
Latitude / Easting: 399456 Longitude / Northing: 6436365 Waypoint #: 013

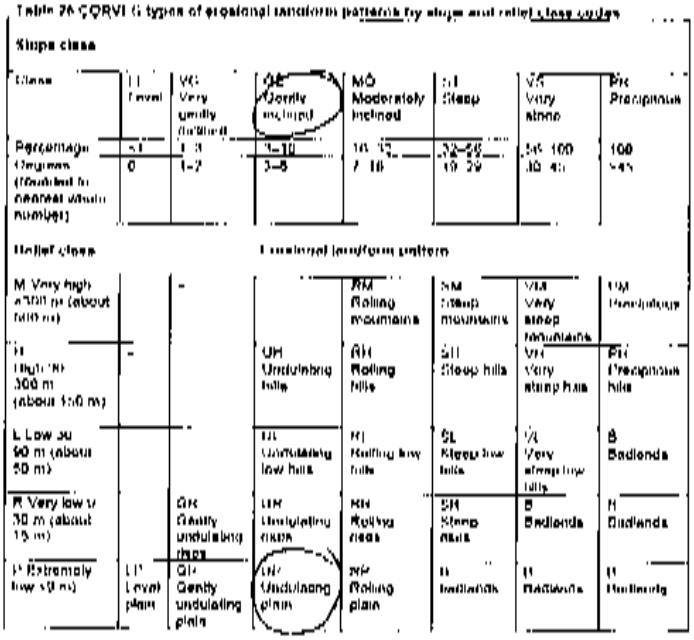
Photo: 2672 / 2673

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	
(Pale)	Silty	Silt	
Yellow	(Sandy)	Loam	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
Dark		Saline Mud	
Black			
Mottled			

Altitude: 95 m Slope: Aspect: N; NF; F; SF; S; SW; W; NW

Landform: Bank is moderate to steep (3m bank)





Disturbance

Fire scars: %

Foral animal: %

Woods: fire weed <5 %

Other: Erosion on banks / grazing / cattle track %20

Health: Pristine / Excellent / Very Good / (Good) / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural:

Recreational:

Conservation: movement corridor

Commercial:

Other Notes:

Width of community: (<35m wide) 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: (<35m wide) 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; (1-5ha;) 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent	20	<5%	10% Bare ground
Canopy	8	70%	esp. on banks
Mid	3	40%	
Ground	0.5	60%	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
Callistemon salignus	D	T		8					
E. tereticornis	O	T		10					
Mel. linearifolius	F	T		6					
Trysmanopsis laurina	O	T		8					
Backhousia myrtifolia (S)	F	T					3		
E. moluccana	O	T	20						
Notelaea venosa (S)	R	T					3		
Angophora subvelutina	R	T	20						
Parsonsia straminea (monocot)	R	V							
Maclura cochinchinensis (rock spur)	R	V							
Lomandra hystrix	F	G							0.6
Pteridium esculentum	F	Fern							0.5
Imperata cylindrica	F	G							0.5
* Senecio madagascariensis	O	Herb							0.2

(*) KEITH - NSW 1 - DRY RAINFOREST
(*) CRA - FE 16 8 RAINFOREST

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: ..E4.07..... Assessor: ..JB1 CL..... Date: ..21../..09../2008

Location: ..KP21 → Along intersection of powerlines.....

GPS Projection: Lat-Long; (UTM) Datum: (GDA94); WGS84; AGD84 Zone: ..56.....

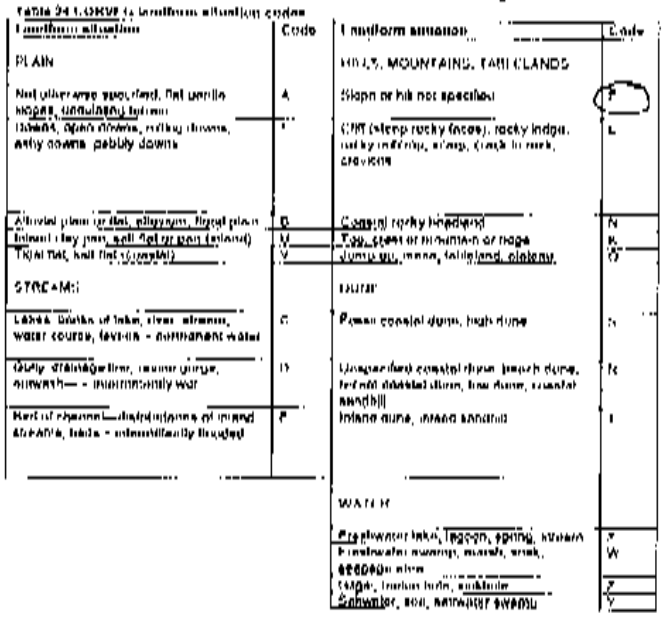
Latitude / Easting: ..0898393... Longitude / Northing: ..6438942..... Waypoint #: ..028...

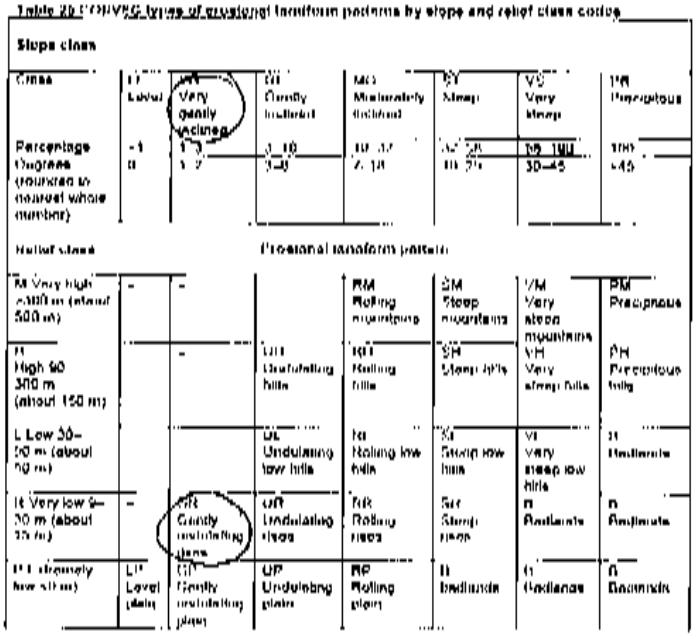
Photo: ..2108/.....

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	(Clayey)	Clay	
Pale	Silty	Silt	
Yellow	Sandy	(Loam)	
Orange	Gravelly	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: ..125.....m Slope: ..... Aspect: N; NE; (E) SE; S; SW; W; NW

Landform: ..Gently undulating Rises.....





Disturbance

Fire scars: ..old >3m.....%....

Feral animal: ..—.....%...

Weeds: ..✓.....%..10

Other: ..clearing E of boundary for powerlines / logging.....%...

Health: Pristine / Excellent / Very Good / Good / (Average) / (Degraded) / Completely Degraded (almost without natives)

Special significance

Cultural: ..—.....

Recreational: ..—.....

Conservation: ..large remnant patch.....

Commercial: ..—.....

Other Notes: ..Construct pipeline E of remnant b/w veg line.....

.....and powerline 10m gap.....

.....

*Solanum sp. 2 – Photo 2707.....

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			No bare ground
Canopy	15	60	
Mid	2	10	
Ground	0.3	10	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

	Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
	E. punctata (s)	D	T		15					
	E. siderophloia	O	T		15					
	E. tereticornis (s)	O	T		15					
	C. citriodora	O	T		15					
	Pratia purpurascens	O	H							0.1
	Leucopogon juniperis	F	H							0.5
	Exocarpus cupressiformis (native cherry)	O	Sh						1	
	Solanum sp1 (wild tomato)	O	H							0.5
	Bursaria spinosa	R	Sh						1	
	Solanum pungetium	O	H							0.2
*	Centella asiatica (trinty wort)	A	H							0.1
**	Romulea rosea (s) (purple Lilly)	O	H							0.2
	Dianella caerulea	O	H							0.2
**	Oxalis corniculata (yellow)	R	H							0.10
*	Briza minor		G							
*	Cirsium vulgare (bristles (purple))	O	H							0.5
**	Lantana camara	A	Sh						2	
*	Senecio madagascariensis	R	H							0.2

(*) KEITH - NSW 21 - NORTHERN HINTERLAND SEMI-MESIC FOREST
(*) CRA - FE 134 - SOUTH COAST SHRUBBY GRE.1 GUM

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: FL 08 Assessor: JB + CL Date: 31 / 08 /2008

Location: Kowah River Rossing (KP25)

GPS Projection: Lat-Long; (UTM) Datum: (GDA94) WGS84; AGD84 Zone: 56

Latitude / Easting: 0397412 Longitude / Northing: 6426427 Waypoint #: 024

Photo: 2697 / 2698

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	
Pale	Silty	Silt	
Yellow	(Sandy)	Loam	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
Dark		Saline Mud	
Black			
Mottled			

Altitude: 54 m Slope: Aspect: N; NF; F; SF; S; SW; W; NW

Landform: River with moderate - steep banks with cleared pasture land

Table 24 CORVEG: landform situation codes

Landform situation	Code	Landform situation	Code
PLAIN		HILLS, MOUNTAINS, TABLELANDS	
Not otherwise specified, flat or gentle slopes, undulating terrain	A	Slope or hill not specified	F
Drowned, quite deeply, rolling ridges, valley downs or bay shores	S	Cliff (steep rocky face), rocky ledge, rocky outcrop, scarp, crack in rock, crevices	L
Alluvial plain or flat, alluvium, flood plain (inland, dry river, soil flat or just exposed) Tidal flat, soil flat (exposed)	D U V	General rocky terrain, Tor, crest of mountain or ridge (tumulus, cairns, tablelands), plateau	N K O
STREAMS		DUNE	
Lakes, banks of lake, river, stream, water course, levees - permanent water	C	Linear seaside dune, high dune	G
Gully, drainage line, narrow gorge, gutter/rush - intermittently wet	H	Unconsolidated coastal dune, beach dune, recent coastal dune, low dune, coastal sandhill	R
Bed of channel - distinguishable or inland streams, banks + intermittently flooded	F	Inland dune, inland sandhill	T
		WATER	
		Freshwater lake, lagoon, swamp, stream Freshwater swamp, marsh, wet, seepage area Ocean, marine park, estuary Saltwater, non saltwater swamp	W SW E V

Table 26 CORVEG: types of prevalent landform patterns for slope and relief class codes

Slope class

Class	LE Level	VG Very gently inclined	GE Gently inclined	MO Moderately inclined	SI Steep	VS Very steep	PR Precipitous
Percentage	<1	1-3	3-10	10-32	32-56	56-100	100
Degrees (rounded to nearest whole number)	0	1-2	3-6	7-18	19-29	30-45	>45

Relief class

Dominant landform pattern

M Very high >300 m (about 500 m)				RM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous
H High 90-300 m (about 150 m)	-	-	UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills
L Low 30-90 m (about 60 m)	-	-	UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	B Badlands
K Very low 0-30 m (about 15 m)		DK Gently undulating rises	UK Undulating rises	RK Rolling rises	SK Steep rises	B Badlands	B Badlands
P Extremely low <2 m	LP Level plain	DP Gently undulating plain	UP Undulating plain	RP Rolling plain	B badlands	B badlands	B badlands

Disturbance

Fire scars: — %

Feral animal: Fox (scat ??) %

Weeds: %20

Other: Horses & cattle tracks %

Health: Pristine / Excellent / Very Good / Good / (Average) / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural:

Recreational:

Conservation: Riparian corridor / habitat / scenic aspect

Commercial: —

Other Notes: HDD recommended

+ flowing water

+ playgrass possible

Width of community: <35m wide ; (35-75m) ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; (35-75m) ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

down to ridge veg

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			major veg type of steep banks is erotic wandering one
Canopy	12	80%	
Mid	4	30%	
Ground	0.5	10-50%	30 40% Bare Ground

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

	Species		Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
	Waterhousia floribunda	(weeping)	F	T			8				
	Syzygium australe		A	T			10				
*	Prunus persica	Peach Tree	O	T				4			
	Melia azedarach	white cedar	R	T			8				
*	Solanum mauritianum	tobacco bush	F	Sml T				2.5			
*	senecio madagascarensis		R	H							0.3
**	Agerahna riparia	flower	F	S							0.5
	E. tereticornis		F	T		15					
	Commelina cyanea	wandering jew	A	H							0.2
	Callistemon salignus (s)		R	T				4			
	Backhousia myrtifolia		F	T				5			
**	Ligustrum sinense	small leaf privet	O	sh.					1.5		
	Cryptocarya glaucescens	(s) Laurel	R	T				6			
	Casuarina cunninghamiana		F			15					
	Waterhousia floribunda		A	T			10				
	Lomandra hystrix		F	H							0.5

(+) KFITH - NSW4 -- DRY RAINFOREST
(*) CKA - FF 168 -- RAINFOREST

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species. + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: PL09 Assessor: JB+CL Date: 30/08/2008

Location: West of Karuah River (KP27)

GPS Projection: Lat-Long; (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

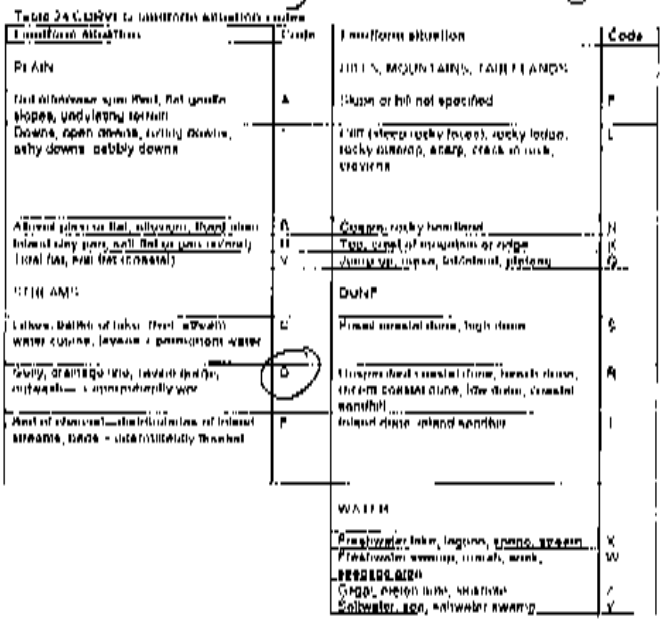
Latitude / Easting: 0397554 Longitude / Northing: 6424708 Waypoint #: 009

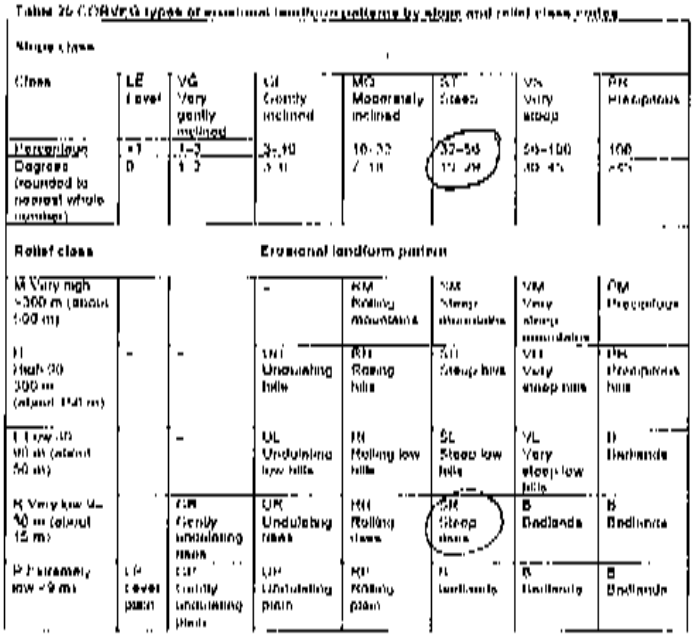
Photo: 2660 / 2661

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	wet/moist
Pale	Silty	Silt	
Yellow	(Sandy)	Loam	
Orange	Gravely	(Sand)	
(Brown)	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: 61 m Slope: Moderate / Steep Aspect: N; NE; E; SE; S; SW; W; NW

Landform: Gully with drainage / creek line @ bottom (dry)





Disturbance

Fire scars: - %

Feral animal: - %

Weeds: Numerous %75

Other: Grazing / cattle track up North <%5

Health: Pristine / Excellent / Very Good / Good / Average / (Degraded) / Completely Degraded (almost without natives)

Special significance

Cultural:

Recreational:

Conservation: veg. corridor

Commercial:

Other Notes: HWR

Sediment control

Width of community: <35m wide ; (35-75m) ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; (35-75m) ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; 1-5ha; (5-20ha) ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information — Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			mostly cleared cattle pasture N & S of Gully.
Canopy	16	50%	
Mid	2·5	75%	
Ground	0·6	10% – 100%	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
E. umbra (s)	D	T		16					
E. siderophoia	O	T		16					
Alphitonia excelsa	O	T			14				
Melaleuca styphelioides	R	T			10				
* Solanum mauritianum	F	T					3		
Hibiscus heterophyllus	R	Sh					3		
Notelaea venosa (s)	O						2·5		
clematis aristata	R	V							
Senna acclinis	O	T					2·5		
Maclura cochinchinensis milk spur	O	V							
** Lantana camera	D	Sh					2		
* (Stinging Nettle) Urtica incisa	O	Herb							0·8
** Ageratina riparia (s)	F	Herb							0·6
* Plantago lanceolata (s)	R	Herb							0·5

(*) KEITH - NSW 69 - HUNTER MACLEAY DRY SCLEROPHYLL FOREST
(*) CRA - FE 33 DRY FOOTHILLS SPOTTED GUM

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: FL10 Assessor: JB | CL Date: 31/08/2008

Location: Karuah River (KP 29 2)

GPS Projection: Lat-Long; (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

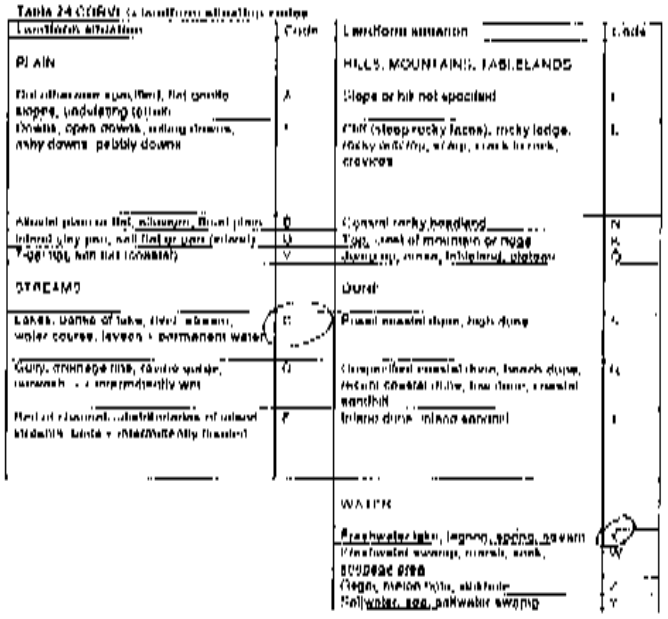
Latitude / Easting: 398263 Longitude / Northing: 6422887 Waypoint #: 042

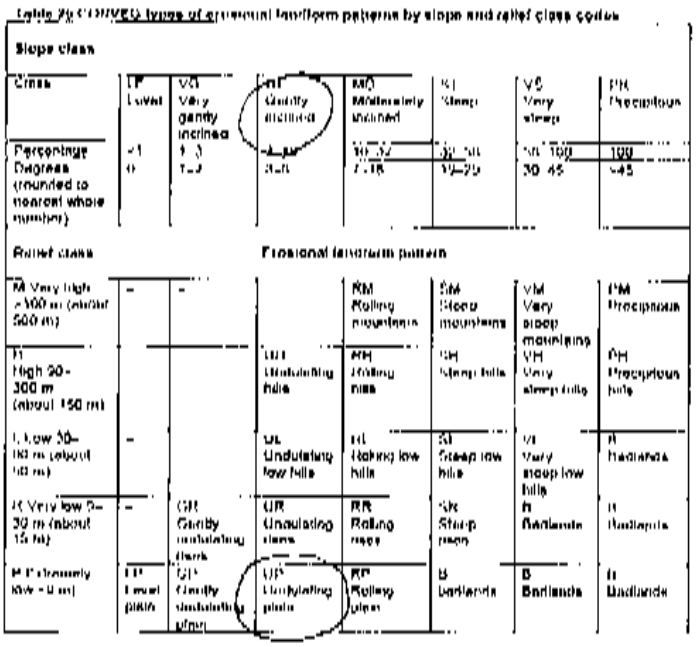
Photo:

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	clay on banks
Pale	(Silty)	Silt	silty/sandy banks
Yellow	(Sandy)	Loam	in river pebbles
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
Dark		Saline Mud	
Black			
Mottled			

Altitude: 80 m Slope: Aspect: N; NE; E; SE; S; SW; W; NW

Landform: stream w moderate to steep banks





Disturbance

Fire scars: — %

Feral animal: — %

Weeds: ✓ %20

Other: cattle tracks/flood debris %5

Health: Pristine / Excellent / Very Good (Good) (Average) / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: —

Recreational: —

Conservation: Corridor

Commercial: —

Other Notes: HDD recommended

Width of community: <35m wide ; (35-75m) ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			Large pebbles/rocks along creek bank
Canopy	14	50/(N)/80/(T)	Bare ground 10%
Mid	8	30%	
Ground	1	0 - 80%	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
Alloxasuarina (Allocasuarina) cunninghamiana	A	T		16					
* Prunus persica (Peach tree)	K	T				3			
Syzygium australe (s)	A	T		14					
** Ageratina riparia	F	Sh						0.8	
Acacia floribunda (s)	I	Sh					1.5		
Hibbertia (Hibbertia) virgata	F	Sh					1.5		
Native plum olive (Olea paniculata)	O	Sh					2		
Duboisia myoporoides (s)	O	T			8			1	
Melaleuca malakoalaricum	R	Sh					1		
Rubus spinosa	O	Sh					1		
(Lophos/myrt) Tristaniopsis laurina	O	T			10				
Lomandra hystrix	A	Herb					1		
E. tereticornis (Narrow leaf)	A	T		16					
Waterhousia floribunda	A	T		14					
** Ligustrum sinense	O	Sh					1.5		
** Lantana camara (Narrow leaf)	A	Sh					1		
Commelina cyanea Wandering Jew	F	Herb							0.2

(*) KEITH - NSW4 - DRY RAINFOREST
(*) CRA - FE 168 - RAINFOREST

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic, Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: FL 11 Assessor: JBT CL Date: 31/05/2008

Location: Black Camp Road (KP 38)

GPS Projection: Lat-Long; (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

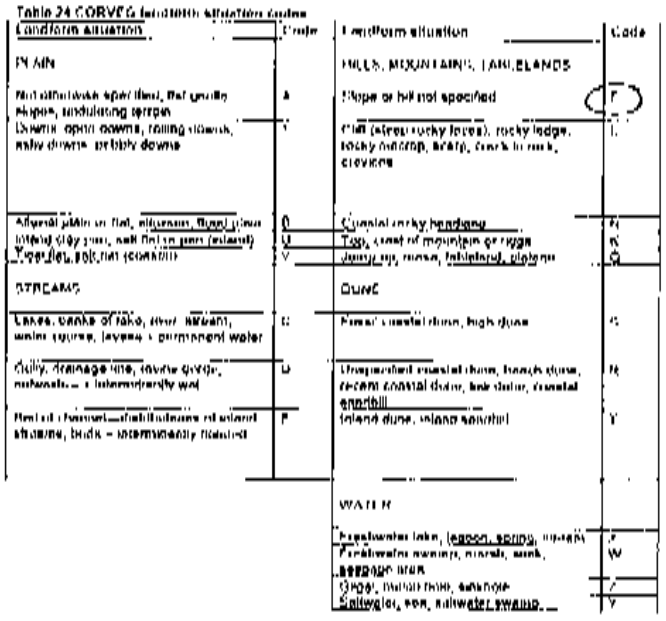
Latitude / Easting: 396 287 Longitude / Northing: 6414 302 Waypoint #: 0121

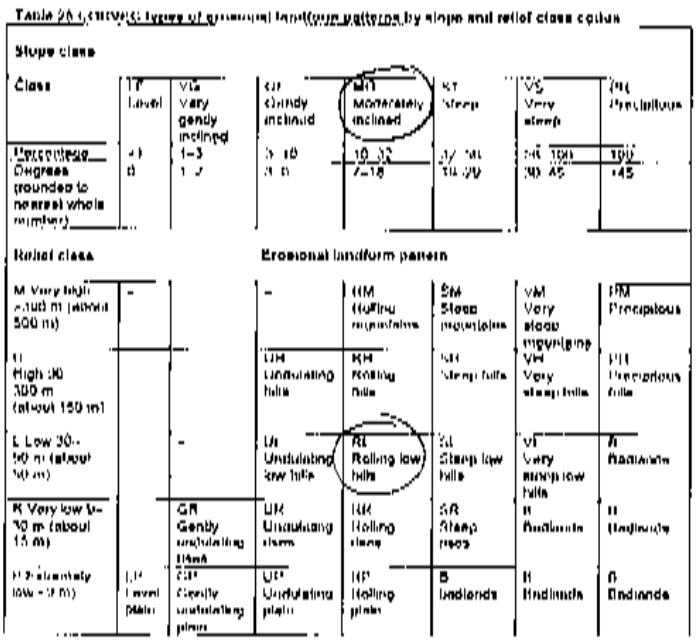
Photo: 2683 (facing W); 2694 (facing E)

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	
(Pale)	Silty	Silt	
Yellow	(Sandy)	Loam	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
Dark		Saline Mud	
Black			
Mottled			

Altitude: 115 m Slope: Aspect: N; NE; E; SE; S; SW; W; NW

Landform: hill slope (moderate)





Disturbance

Fire scars: up to 4m %50%

Feral animal: %

Weeds: %

Other: logging / past clearing / Erosion %5%

Health: Pristine / Excellent / Very Good / Good / (Average) / Degraded / Completely Degraded (almost without natives)

previous clearing

Special significance

Cultural:

Recreational:

Conservation: Large area with some large trees in w

Commercial:

Other Notes: small (up to 5 (uphill) large (up (DBH >1m) in good condition
also to hut hike to E in smaller trees (possibly previously cleared)
ground orchid - ph 2685 - 2691

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			5-10% bare ground
Canopy	14	30	
Mid	3	50	
Ground	0.5	50	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
E. siderophloia	A	T		14					
E. umbra	D	T		14					
C. citriodora	O	T		14					
M. styphelioides	O	T				5			
All. torulosa	O	T				5			
Jacksonia scoparia	O	Esh					2		
A. irrorata	R	T					2		
Acacia blakei (S)	F	T					2		
Bursaria spinosa	A	Sh					2.5		
Acacia ulicifolia	F	Esh					2		
Leucopogon juniperinus	O	Esh					1		
Pultenaea villosa (S)	O	Sh					1		
Hovea longifolia var. violacea	O	V							
Petalochilus calanatus (S)	O	H							0.2
Daviesia ulicifolia subsp. ulicifolia (S)	O	Herb							1
Tricoryne tricarica	F	G							0.5
Imperata cylindrica	F	G							0.7
Lomandra longifolia	F	Herb							1
Xanthorrhoea johnsonii	O	Sh							1
Dianella caerulea	F	Herb							0.7
Dodonaea triquetra (S)	O	Sh					2		2

(#) KFH H - NSW69 - HUNTER MACLEAY DRY SCLEROPHYLL FOREST
(*) CRA - FF33 - DRY FOOTHILLS SPOTTED GUM

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: FL 12 Assessor: JB+CL Date: 02/09/2008

Location: Black camp Road (KP 39)

GPS Projection: Lat-Long; (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

Latitude / Easting: 0396015 Longitude / Northing: 6412314 Waypoint #: 057

Photo: 2 7 9 2

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	(Clayey)	Clay	with large sandstone rock (metamorphic?)
(Pale)	Silty	Silt	
Yellow	Sandy	Loam	
(Orange)	Gravely	(Sand)	
Brown	Stony	Gravel	
Red			
Dark		Saline Mud	
Black			
Mottled			

Altitude: 220 m Slope: Aspect: N; NE; E; SE; S; SW; W; (NW)

Landform:

Table 24 CORVEG landform situation codes

Landform situation	Code	Landform situation	Code
PLAIN		HILLS, MOUNTAINS, FAN PLAINS	
Not otherwise specified, flat ground	A	Slope or hill not specified	I
Downs, open downs, rolling downs,	L	Cliff (steep rocky face), scarp, tor, rocky outcrop, karst, crack in rock	I
Alluvial plain or flat, gilgai, mud plain	G	Coastal rocky headland	N
Inland salt pan, salt flat or plain (playa)	V	Tor, level of exposure on ridge	K
Tidal flat, salt flat (coastal)	V	Hummock, mesa, inselberg, plateau	Q
SEMI ARID		DUNE	
Lakes, banks of lake, river, stream, water courses, leaves + permanent water	C	Coastal dune, high dune	R
Gully, drainage line, ravine gorge, outwash + intermittently wet	D	Unvegetated coastal dune, beach dune, recent coastal ridge, low dune, coastal sandhill	H
Bed of channel, distributaries of inland streams, beds + intermittently flooded	I	Inland dune, inland sandhill	T
		WATER	
		Freshwater lake, lagoon, spring, stream	X
		Freshwater swamp, bottom, soak, seepage area	W
		Ridge, melon hole, sinkhole	Z
		Saltwater, sea, saltwater swamp	Y

Table 25 CORVEG types of erosional landform pattern by slope and relief class codes

Slope class							
Class	1 Level	VG Very gently inclined	GE Gently inclined	MO Moderately inclined	SY Steep	VS Very steep	PR Precipitous
Percentage	<1	1–3	3–10	10–30	30–56	56–100	100
Degrees (rounded to nearest whole number)	0	1–2	3–5	7–16	16–29	30–45	>45

Relief class	Erosional landform pattern						
M Very high >300 m (above 900 m)	–	–		RM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous mountains
H High hill 80–300 m (about 150–900 m)	–	–	UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills
L Low hill 30–80 m (about 90 m)	–	–	UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	B Badlands
V Very low 8–30 m (about 15 m)	–	Gen Gently undulating rises	UR Undulating rises	RR Rolling rises	SR Steep rises	B Badlands	B Badlands
E Extremely low <8 m	LP Level plain	GP Gently undulating plain	UP Undulating plain	RP Rolling plain	R Badlands	R Badlands	R Badlands

Disturbance

Fire scars: up to 5m ? %20

Feral animal: - %-

Weeds: ✓ <%5

Other: logging (some) <%5

Health: Pristine / Excellent / Very Good / (Good ?) / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: -

Recreational: -

Conservation: Remnant veg

Commercial: -

Other Notes: construct pipe in road corridor if necessary extend uphill SE (erosion control)

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	16	40%	5% Bare ground mostly leaf litter
Mid	8	30%	
Ground	1	30%	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
C. citriodora	F	T		16					
E. umbra	D	T		16					
E. propinqua	O	T		16					
E. microcorys	O	T		16					
Indeterminate (Compacta Leaf Shrub)	O	Sh					2		
Acacia irrorata (Wally leaf)	R	sm T					2		
Podolobium ilicifolium (S) (prickly pea)	F	sh					1.5		
Allocasuarina torulosa	A	sm T				8			
Daviesia ulicifolia subs. stenophylla	R	sh							0.8
Jacksonia scoparia (S)	O	sm T					2		
Pultenaea villosa	O	sh							0.3
Acacia ulicifolia	O	sh					1.5		
Themeda triandra	O	G						1.5	
Lomandra longifolia	F	G						1.0	
Dianella sp.	O	H						1.0	
Imperata cylindrica	A	G							0.8
* Senecio madagascariensis	O	H							0.3

(*) KEITH - NSW 69 - HUNTER MACLEAY DRY SCLEROPHYLL FOREST
(*) CRA - FE 33 - DRY FOOTHILLS SPOTTED GUM

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: FL 13 Assessor: JB+CL Date: 02/09/2008

Location: Black Camp Road (Dark veg from arial map) (KP41)

GPS Projection: Lat-Long: (UTM) Datum: (GDA94) WGS84; AGD84 Zone: 56

Latitude / Easting: 0395185 Longitude / Northing: 6411589 Waypoint #: 058

Photo: 2749

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	(Clayey)	Clay	
Pale	Silty	Silt	
Yellow	Sandy	Loam	
(Orange)	Gravely	(Sand)	
Brown	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: 130 m Slope: Aspect: N; NE; E; SE; S; SW; W; NW

Landform: foothill of steep slope.

Table 24 CQIVEG landform situation codes

Landform situation	Code	Landform situation	Code
PLAIN		HILLS, MOUNTAINS, TABLELANDS	
Not otherwise specified (flat gentle slopes, undulating) (major)	A	Slope or rise not specified	P
Downs, open downs, rolling downs, delay downs, patchy downs	T	Cliff (steep rocky face), rocky range, rocky outcrop, scarp, crack in rock, crevice	L
Alluvial plain or flat, playa, flood plain (inland city pan, salt flat or pan (inland)	D	Coastal rocky headland	N
Tidal flat, salt flat (coastal)	V	Hill, crest or ridge (of range)	K
		Jump-up, mesa, (tableland), plateau	O
COASTAL AREA		DUNE	
Lakes, banks of lake, river, stream, water course, lagoon + permanent water	C	Foredune consolidated dune, high dune	H
Gully, drainage line, canyon gorge, defile/pass + intermittently wet	G	Unspecified consolidated dune, beach dune, inland coastal dune, low dune, coastal sandhill	K
Bed of channel, watercourse or inland streams, beds + intermittently flooded	F	Inland dune, inland sandhill	I
		WATER	
		Freshwater lake, lagoon, billabong, waterhole	Y
		Freshwater swamp, marsh, soak, seepage, spring	W
		Ridge, ravine/gully, sinkhole	J
		Saltwater, bay, saltwater swamp	V

Table 25 CQIVEG types of associated landform patterns by slope and relief class codes

Slope class

Class	XF Level	VG Very gently inclined	GE Gently inclined	MO Moderately inclined	SE Steep	VS Very steep	EM Precipitous
Percentage (degrees (rounded to nearest whole number)	<1 0	1-3 1-2	3-10 3-6	10-32 6-18	32-60 18-31	60-100 31-45	>100 >45

Relief class — Erosional landform pattern

M Very high (>300 m (about >300 m)	–	–	–	RM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous mountains
H High (>90-300 m (about 150 m)	–	–	UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills
L Low (>9-90 m (about 50 m)	–	–	UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	B Badlands
R Very low (0-9 m (about 10 m)	–	GR Gently undulating rises	UR Undulating rises	RR Rolling rises	SR Steep rises	B Badlands	B Badlands
P Extremely low (<1 m)	LP Level plain	GP Gently undulating plain	UP Undulating plain	RP Rolling plains	B Badlands	B Badlands	B Badlands

Disturbance

Fire scars: -- %

Feral animal: -- %

Weeds: ✓ %50

Other: Some logging %5

Health: Pristine / Excellent / Very Good / Good / (Average) (Degraded) / Completely Degraded (almost without natives)

Special significance

Cultural: --

Recreational: --

Conservation: Rare vegetation type (vanraven) / Remnant veg

Commercial: --

Other Notes: Keep pipe to road corridor

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	20	60	10% bare ground → pebbles/rocks
Mid	3	70	
Ground	0.2	20	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

	Species	Rel. Dom.	Form	E	Ht (m) T1	T2	T3	S1	S2	G
	E. maculata	O	T		18					
	E. propinqua	D	T		20					
	E. microcorys	F	T		20					
	E. terricornis	O	T		20					
	Apamanthe philippinensis	R	T		6					
	Backhousia myrtifolia	R	T					2		
	Cissus antarctica (Native grape)	O	V							
	Cissus opaca (Grape vine)	O	V							
	Geitonoplesium cymosum (climbing lily)	O	V							
	Melaleuca melanothrix (Blue orange)	R	Sh					1		
	Alphitonia excelsa	F	Sh					2		
	Acacia irrorata	O	Sh					1		
	Hibiscus sp.	F	Sh					1		
	Ozothamnus diosmifolius	O	Sh					1.5		
	Lomandra longifolia	O						1		
	Goodenia ovata	O	H					1		
	Zieria smithii (s)	R	Sh					1.5		
**	Lantana camara	A	Sh					2		
	Stellaria flaccida (Forest starwort)	F	H							0.1
*	Bidens pilosa (Cobblers pegs)	O	H							0.3
	Ficus coronata (s) Sandpaper fig	O	T					3		
	Diospyros australis	O	T					3		
*	Senecio madagascarensis	O	H							0.2

(#) KEITH - NSW 21 - NORTHERN HINTERLAND SEMI-MESIC FOREST

(¥) ORA - FE134 - SOUTH COAST SHRUBBY GREY GUM

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling.
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: FL14 Assessor: IB+CL Date: 01/09/2008

Location: KP 495 MIDDLE – At stream bend (area contained) pasture land N+S

GPS Projection: Lat-Long; (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

Latitude / Easting: 0397355 Longitude / Northing: 6407956 Waypoint #: 034

Photo: 2709

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	(Clayey)	Clay	
Pale	Silty	Silt	
Yellow	Sandy	(Loam)	
Orange	Gravelly	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: 60 m Slope: Aspect: N; NE; E; SE; S; SW; (W); NW

Landform: Very gentle slope plain

Table 24 CORVEG landform attribute codes

Landform attributes	Code	Landform attributes	Code
PLAINS		HILLS, MOUNTAINS, TABLELANDS	
Not otherwise specified, flat or gently undulating terrain	A	Slope or hill not specified	F
Gilgais, open drainage, drifting streams, sandy downs, patchy downs	F	Cliff (steep rocky terrain), rocky ledge, rocky outcrop, scarp, crack in rock, crevices	L
Alluvial plain or flat, riverine, flood plain	R	Coastal rocky headland	N
Inland rocky plain, salt flat (or pan) (playa)	U	Gap, crest of mountain or ridge	K
Tidal flat, mud flat (coastal)	V	Sand dune, swamp, tableland, plateau	Q
STREAMS		LAKES	
Lakes, bathe of lake, river, streams, water course, levees + permanent water	C	Inland consolidated dune, high dune	S
Gully, drainage line, riverine gorge, gutterway + intermittently wet	D	Unconsolidated coastal dune, beach dune, FRONT COASTAL shelter, low dune, coastal sandhill	R
Mud or channel—intermittent or ground elevation, bank + intermittently flooded	E	Inland dune, inland sandhill	T
		WATER	
		Freshwater lake, lagoon, spring, permit	V
		Freshwater swamp, marsh, soak, waterhole dam	W
		Brackish, slightly saline, subsaline	/
		Saltwater, sea, saltwater swamp	Y

Table 25 CORVEG types of erosional landform patterns by slope and relief class codes

Slope class	LE Level	VG Very gently inclined	GI Gently inclined	MO Moderately inclined	ST Steep	VS Very steep	PR Precipitous
Percentage (degrees (rounded to nearest whole number))	0–1 (0)	1–3 (1)	3–10 (3–5)	10–32 (6–17)	32–58 (18–30)	58–100 (31–45)	100 (>45)

Relief class	Erosional landform pattern						
M Very high (>500 m (about 500 m))				RM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous mountains
H High (90–500 m (about 100 m))	–	–	UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills
L Low (30–90 m (about 50 m))	–	–	UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	B Badlands
V Very low (<30 m (about 15 m))		GR Gently undulating plains	UR Undulating rises	RR Rolling rises	SR Steep rises	R Badlands	B Badlands
E Extremely low (<5 m)	LE Level plain	GR Gently undulating plain	UR Undulating plain	RR Rolling plain	R Badlands	R Badlands	B Badlands

Disturbance

Fire scars: ~3-4m %20

Feral animal: – %

Weeds: ✓ >%5

Other: some logging / track west of remnant >%5

Health: Pristine / Excellent / Very Good (Good) / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: –

Recreational: –

Conservation: Reasonable sized remnant patch, near river bed

Commercial: –

Other Notes: stream/river west of remnant sml strip of regrowth, track and cleared veg to west b/w river and remnant

Suggest site 035 (regrowth) and leave buffer for creek

Regrowth + track to fence line = 15m

fence line to creek = 5m

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			Bare ground 5%
Canopy	16	50	
Mid	3	60	
Ground	0.3	40	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
C. citriodora	F	T		16					
E. siderophloia	F	T		16					
E. melicamma	O	T		16					
E. umbra	D	T		16					
M. nodosa	A	sml T					3		
Pultenaea villosa	F	Sh						1	
A. ulicifolia	F	Sh						1.5	
Exocarpus cupressiformis	F	sml T						1.5	
A. irrorata (s)	O	sml T					2		
Ozothamnus diosmifolius	O						2		
Daviesia ulicifolia sub. stenophylla	O	Sh							0.5
Lucopogon juniperinus	O	Sh							0.5
Dianella caerulea	O	H							0.3
Entolasia stricta (Wiry Grass)	F	G							0.8
Cassytha pubescens (Dodder Laurel)	R	V							
Hardenbergia violacea	O	V							
Geitonoplesium sp (Climbing Lily)	R	V							
* Senecio madagascariensis	R	H							0.3
Poa sieberiana var sieberiana	O	G							0.2

(*) Key - NSW 69 - Hunter Macleay Dry Sclerophyll Forest
(#) CRA - FF 33 - Dry Foothill Spotted Gum

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; > = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: FL 15 Assessor: JB, CL Date: 03/09/2008

Location: SMITH CREEK CROSSING (KP 56.5)

GPS Projection: Lat-Long (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

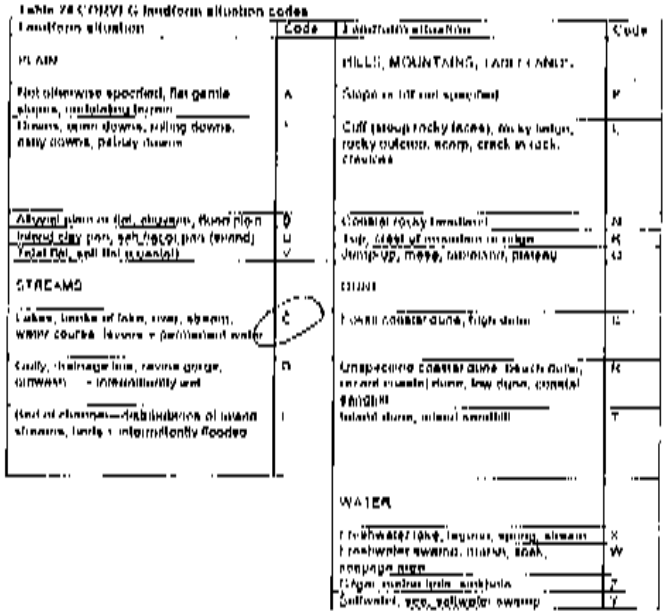
Latitude / Easting: 0390395 Longitude / Northing: 6401440 Waypoint #: 062

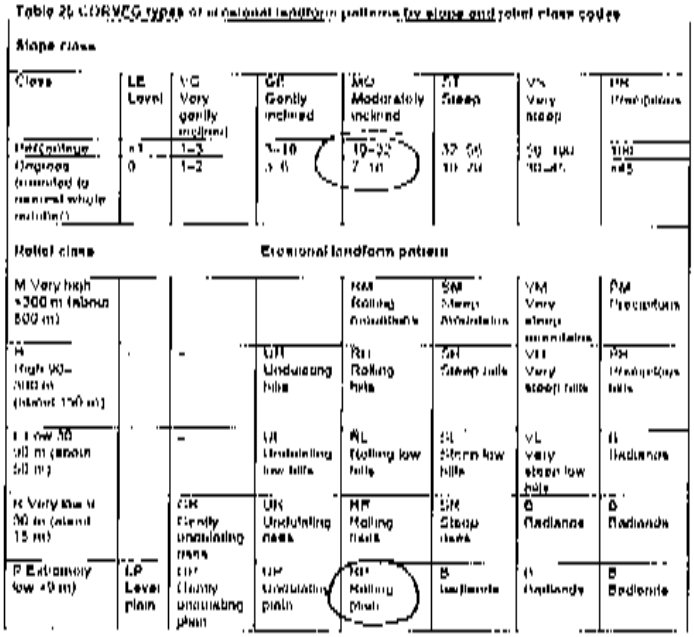
Photo: 2757 / 2758 / 2759 (corridor shot)

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	(Clayey)	Clay	stoney sand in creek bed
Pale	Silty	(Silt)	
Yellow	Sandy	Loam	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Soling Mud	
Black			
Mottled			

Altitude: 70 m Slope: Aspect: N; NE; E; SE; S; SW; W; NW

Landform: Dry stream bed with moderate slopes





Disturbance

Fire scars: — %

Feral animal: ✓ Hares <5%

Weeds: ✓ <30%

Other: Cattle (now fenced off) <5%

Health: Pristine / Excellent / Very Good / Good / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: —

Recreational: —

Conservation: Corridor connecting 2 lrg veg areas / maybe rare veg type

Commercial: —

Other Notes: HDD if possible. Minimum width necessary/essentially just the width of pipe. South of site remnant stand of eucalypt trees to avoid (go down hill)

Width of community: (<35m wide) ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Total community area: Does not extend beyond site; <1ha ; (1-5ha) 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information — Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			Bare ground = 30%
Canopy	8	80%	Pebbles, stones and cobblers
Mid	3	50%	on stream bed (no water)
Ground	0.5	20	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

	Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
	Backhousia myrtifolia	D	T		8					
	Hibiscus heterophyllus	F	T		8					
	Aphananthe philippinensis	F	sml T						2	
	Indeterminate (s) rough-barked terrestrial	O	sml T						1.5	
	Syzygium australe	A	T		8					
*	Acacia leiocalyx (s)	R	T		10					
	Pyrrosia confluens (climbing fern)	R	F							
	Notelaea venosa (native olive)	R	S						1.5	
	Mallotus philippensis (red kamala)	O	S				3			
	Pittosporum undulatum (Mellow fruited)	R	S						1.5	
**	Rubus ulmifolius	R	S						1.5	
#	Leucopogon juniperinus.	R	S						1	
	Cissus antarctica	R	V							
	Eustrephus latifolius (wombat vine)	R	V							
	Platycerium superbum staghorn fern	R	F							
	Maclura cochinchinensis (cockspur)	O	V							
	Pandorea pandorana (s) 5-leaflet vine	R	V							
*	Kennedia rubicunda red-flowered	R	V							
	Bursaria spinosa	A	Sh						1.5	
**	Lantana camara	F	Sh				3			
¥	Bidens pilosa	R	H							0.8
¥	Senecio madagascaris	O	H							0.2
	Scleria sp. rough sedge	F	Sed							0.7

(#) KEN 4 = NSW 4 – Dry Rainforest
(#) CRA – FE 16 8 – Rainforest

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; ^ = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)
(#) LHCREMS – MU 3 – Hunter Valley Dry Rainforest

cleared pasture

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: FL 16 Assessor: JB, CA Date: 03 / 09 /2008

Location: MAIN PROPERTY - remnant veg N powerlines driving (KP61)

GPS Projection: Lat-Long; (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

Latitude / Easting: 0389900 Longitude / Northing: 6396446 Waypoint #: 063

Photo: 2760 / 2761

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	Clay	
Pale	Silty	Silt	
Yellow	(Sandy)	(Loam);	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Soling Mud	
Black			
Mottled			

Altitude: 45 m Slope: Aspect: N; NE; E; SE; (S); SW; W; NW

Landform: Undulating hill slopes

Table 24 CORVEG landform situation codes

Landform situation	Code	Landform situation	Code
PLAIN		HILLS, MOUNTAINS, TABLELANDS	
Not otherwise specified, flat ganda plynes, undulating terrain	A	Slope or hill not specified	I
Downs, open downs, rolling downs, Astby downs, patchy downs	*	Cliff (steep rocky fascia), rocky ledge, rocky outcrop, scarp, crack in rock, Gorge	L
Alluvial plain or flat, alluvium, flood plain (inland clay pan, salt flat or pan (inland) Tidal flat, salt flat (coastal)	Q V V	Coastal rocky headland Tor, crest of mountain or ridge Jump up, mesa, tableland, plateau	N K Q
SEMI-AMI		DUNE	
Lakes, banks of lake, river, stream, water course, lagoon = permanent water	C	Fossil coastal dune, high dune	S
Gully, drainage line, minor gorge, outwash = intermittently wet	D	Unspecified coastal dune, beach dune, coastal foredune, low dune, coastal sandhill	H
Bed of channel = dimensions of inland streams, beds = intermittently flooded	E	Inland dune, inland sandhill	T
		WATER	
		Freshwater lake, lagoon, spring, stream	V
		Freshwater swamp, marsh, soak, seepage area	W
		Ridge, marine beds, saltpans Saltwater, tidal saltwater swamp	Z Y

Table 26 CORVEG types of dominant landform patterns by slope and relief (see codes)

Slope class	LE Level	VG Very gently inclined	GE Gently inclined	MO Moderately inclined	SP Steep	VP Very steep	PR Precipitous
Percentage	<1	1–3	3–10	10–32	32–50	50–100	100
Degrees (rounded to nearest whole number)	0	1–2	3–8	7–18	18–29	30–45	>45

Relief class — Dominant landscape pattern

M Very high >300 m (about 1000 m)	-			RM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous mountains
H High hill 120 m (about 120 m)	-		UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills
L Low hill 30 m (about 50 m)			UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	D Dissected
R Very low to 30 m (about 15 m)		GR Gently undulating rises	UR Undulating rises	RR Rolling rises	SR Steep rises	B Badlands	B Badlands
P Extremely low <9 m	LP Level plain	GP Gently undulating plain	UP Undulating plain	RP Rolling plain	S Escarpments	R Rockplains	R Rockplains

Disturbance

Fire scars: ✓ up to 3m %

Feral animal: — %

Weeds: — %

Other: — %

Health: Pristine / Excellent / Very Good / Good / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: —

Recreational: —

Conservation: large remnant (young) - no large trees though

Commercial: —

Other Notes: keep pipeline to already cleared powerline corridor (125m wide) & conservation reserve

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	15	40	* No bare ground
Mid	6	40	
Ground	0.5	60	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
C. citriodora	F	T		15					
M nodosa	D	sml T				6			
E. siderophloia	O	T		15					
E umbra (S)	F	T		15					
Leptospermum morrisonii	O	sml T					4		
A uncifolia	O	Sh						1.5	
Pultenaea villosa	F	Sh						1.5	
Brachyscia sp. (S) Indet	O	Sh							0.3
Bursaria spinosa	O	Sh						2	
Hardenbergia violacea	R	V							
Daviesia ulicifolia subsp. stenophylla	R	Sh						1	
Lucopogon juniperinus	O	Sh						1	
Petalochilus calanatus	O	H							0.2
Lomandra gracilis	O	G							0.2
Entolasia stricta	A	G							0.5
Poa sieberiana var sieberiana	F	G							0.3
Pratia purpurascens	F	H							0.1
Themeda triandra	O	G							0.5
Gonocarpus tetragynus (Rasp weed)	R	H							0.3
* Andropogon virginicus									

(*) KEITH - NSW 69 - HUNTER MACLEAY DRY SCLEROPHYLL FOREST
(*) CRA - FE 11 - IRONBARK
(*) LHCCREMS - MU 16 - SEAHAM SPOTTED GUM IRONBARK FOREST

Species annotations: S = Specimen Collected; * = Exotic Species; ^ = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional, R = Rare)

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: EL 17 Assessor: JBACL Date: 03 / 09 /2008

Location: KP 65.4 – FINLAYSON

GPS Projection: Lat-Long (UTM) Datum: (GDA94) WGS84; AGD84 Zone: 56

Latitude / Easting: 0336751 Longitude / Northing: 6393744 Waypoint #: 066

Photo: 2803 GREVILLEA SP – P4 2796 – 2802

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish (Pale) Yellow Orange (Brown) Red grey Dark Black Mottled	Clayey Silty (Sandy) Gravely Stony	(Clay) Silt Loam Sand Gravel Saline Mud	

Altitude: 30 m Slope: Aspect: N; NE; E; SE; S; SW; (W); NW

Landform: Gently sloping plain

Table 24 CORVEG landform situation codes

Landform situation	Code	Landform situation	Code
PLAIN		HILLS, MOUNTAINS, TABLELANDS	
Not otherwise specified, flat gentle slopes, undulating terrain	A	Slope or hill not specified	I
Downs, open downs, rolling downs, rolling hillocks, prickly downs	I	Cliff (steep rocky face), rocky range, rocky outcrop, scarp, crack in rock, clint/grike	J
Alluvial plain or flat, alluvium, floodplain	Q	Colluvial rocky footslope	N
Heavy clay pan, gilgai or plain (plains)	U	Tor, inselberg or monadnock or other	K
Tidal flat, salt flat (coastal)	V	Jump up, mesa, interfluve, plateau	O
DRAINAGE		OTHER	
Lakes, banks of lake, swan, stream, water course, flooded = intermittent water	C	Fossil coastal dune, high dune	S
Gully, drainage line, narrow gorge, waterhole = intermittently wet	D	Unspecified coastal dune, beach dune, recent coastal dune, low dune, coastal hummock	R
Bed of channel - discontinuous or ephemeral stream, bank = intermittently flooded	E	Inland dune, inland sandhill	T
		WATER	
		Freshwater lake, lagoon, spring, soakage	X
		Permanent swamp, marsh, soak, seepage area	W
		Estuary, tidal lake, saltpan	Z
		Saltwater, sea, saltwater swamp	Y

Table 25 CORVEG types of erosional landform patterns by slope and relief class codes

Slope class							
Class	L1 Level	L2 Very gently inclined	U2 Gently inclined	M2 Moderately inclined	S2 Steep	V2 Very steep	PR Precipitous
Percentage (Degrees in brackets to nearest whole number)	<1 (0)	1-2 (1)	3-10 (2-5)	10-32 (6-17)	32-70 (18-35)	70-100 (36-45)	>100 (>45)
Relief class	Erosional landform patterns						
M Very high >300 m (about 1000 m)	-	-	-	RM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous
H High 150-300 m (about 150 m)			UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills
L Low 30-150 m (50 m)			UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	R Redlands
V Very low 0-30 m (about 15 m)		GR Gently undulating rises	UR Undulating rises	RR Rolling rises	SR Steep rises	R Redlands	R Redlands
P Extremely low <0 m	L1 Level plain	GP Gently undulating plain	UP Undulating plain	RP Rolling plain	S Saltlands	D Dunelands	D Dunelands

Disturbance

Fire scars: ... %

Feral animal: X %

Weeds: - %

Other: Tracks through veg/ some erosion <5%

Health: Pristine / Excellent / Very Good / (Good) / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: -

Recreational: -

Conservation: Connects to larger remnant -Coast / NP. GREVILLEA PARVIFLORA (VULNERABLE)

Commercial: -

Other Notes: Any construction to be restricted to already cleared area. Use existing tracks if necessary, clear minimum to W

Width of community: <35m wide ; 35-75m ; (75-150m); 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha ?
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	12	50 /	
Mid	3.5	5 / ~10 /	
Ground	0.8	60 /	

All woody species present within 50m x 10m plot (plus dominant and threatenod non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
C. citriodora	O	T		12					
E. siderophloia	D	T		12					
Lepidospermum morrisonii	F	T				2-5			
Exocarpus cupressiformis	R	T				4			
Ozothamnus diosmifolius	O	Sh						1	
Daviesia ulicifolia sub stenophylla	O	Sh							0.5
Ruttenera villosa	D	Sh						1	
Dillwynia sp. 'Trichopoda' (S)	O	Sh							0.5
Grevillea parviflora (spiny flower)	R	Sh							0.4
Dianella caerulea (flat leaf)	O	H							0.5
Xanthorrhoea johnsonii	F	Sh							0.5
Themeda triandra	A	G						1	0.5
Entolasia stricta		G							0.4
Hardenbergia violacea	R	V							—
Wurmbea dioica	O	H							0.2
Lomandra gracilis	O	G							0.3
Ptilothrix deusta (S)	O	H							0.4
Lepidosperma laterale	O	H							0.5
Banocarpus tricornis (easter)	O	H							0.4
Petalochilus catenatus (white orchid)	R	H							0.3

(*) KEITH - NSW 69 - HUNTER MACLEAY SHRUB/GRASS FOREST

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; F = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

(*) LHCCREMS - MU 16 - GRAHAM SPOTTED GUM IRONBARK FOREST

(*) CRA - TE 71 - IRONBARK

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: FL18 Assessor: JBI CL Date: 04/05/2008

Location: Wallaroo Native Reserve KP67 - W of powerline easement

GPS Projection: Lat-Long (UTM) Datum: (GDA94) WGS84; AGD84 Zone: 56

Latitude / Easting: 386542 Longitude / Northing: 6392485 Waypoint #: 074

Photo: 2709 / 2810

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	
Pale	(Silty)	Silt	
Yellow	Sandy	Loam	
Orange	Gravelly	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: 15 m Slope: Aspect: N; NE; E; SE; S; SW; (W) NW

Landform: undulating plain

Table 24 Codes for landform situation codes

Landform situation	Code	Landform situation	Code
(PLAIN)		HILLS, MOUNTAINS, TABLELANDS	
Plain otherwise specified, flat gentle slopes, undulating terrain	A	Slope or hill not specified	E
Drowns, open downs, swing downs, valley downs, pebbly downs	Y	Cliff (steep rocky face), rocky ledge, rocky outcrop, scarp, creek bank, crevices	I
Alluvial plain or flat, tidal plain, flood plain, inland alluvial plain, salt flat or pan (inland), inland flat, salt flat (coastal)	D	Coastal rocky headland	N
	U	Peak, crest of mountain or ridge	K
	V	Hummock, mesa, tableland, plateau	O
STREAMS		Dune	
Lakes, banks of lake, river, stream, water course, levees - permanent water	R	Fixed coastal dune, high dune	S
Gully, drainage line, channel, gorge, watercourse - intermittently wet	D	Unconsolidated coastal dune, beach dune, recent coastal dune, low dune, (Coastal sandhill	H
Bed of a former/ephemeral/intermittent stream, bank - intermittently flowing	F	Inland dune, inland sandhill	I
		WATER	
		Freshwater lake, lagoon, spring, stream	V
		Freshwater swamp, marsh, soak, seepage area	W
		Ocean, major bay, estuary	J
		Saltwater, sea, saltwater swamp	Y

Table 26 CURVES: types of erosional landform patterns by slope and relief class codes

Slope class							
Class	L Level	VG Very gently inclined	GI Gently inclined	MI Moderately inclined	ST Steep	VS Very steep	PR Precipitous
Percentage	<1	1–3	3–10	10–32	32–58	58–100	100+
Degrees (rounded to nearest whole number)	0	1–2	2–6	6–18	18–30	30–45	45+

Relief class	Erosional landform pattern						
M Very high >600 m (about 600 m)	-	-	UM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous	
H High 90 300 m (about 110 m)		UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills	
L Low 30 90 m (about 50 m)	-	-	UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	R Rarelands
R Very low to 30 m (about 15 m)		GR Gently undulating plains	UR Undulating plains	RR Rolling plains	SR Steep plains	R Rarelands	R Rarelands
P Extremely low <15 m	L Level (Mats)	GP Gently undulating plains	UP Undulating plains	RP Rolling plains	B Badlands	B Badlands	B Badlands

Disturbance

Fire scars: - %

Feral animal: %

Weeds: Lantana <5%

Other: some timber cutting <5%

Health: Pristine / Excellent / Very Good / Good / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: -

Recreational: -

Conservation: connects to larger remnant veg (Wallaroo Native Res)

Commercial: -

Other Notes: new pipeline construction to already cleared power line easement (25m width, 3m b/w poles) west side of easement preferable as maximum stop of veg. x No trees > 0.5m DBH on W side of easement

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear] map
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			10% bare ground
Canopy	16	50%	
Mid	5	60%	
Ground	0.5	40%	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
E. siderophloia	A	T		16					
C. citriodora	A	T		16					
M. nodosa	D	sm T				5			
Acacia irrorata	O	Sh						2	
Bursaria spinosa	F	Sh						1-3	
Pultenaea villosa	O	Sh							0.8
Breynia oblongifolia (coffee bush)	O	sh						1	
Lissanthe sapida	O	Sh							0.5
Entolasia marginata	F	G							0.5
Gahnia aspera (saw sedge)	O	Sed						1	
Dianella caerulea	O	H							0.3
Lomandra multiflora	O	H							0.3
Centella asiatica (Penny wort)	O	H							0.1
Wurmbea dioica	O	H							0.1
Pratia purpurascens (purple flowered)	O	H							0.1
Entolasia stricta (wiry)	O	G							0.3
Eustrephus latifolius (wombat berry)	O	V							
Parsonsia straminea (monkey rope)	O	V							
**Lantana camara	O	Sh						1.5	

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

(*) KEITH - HUNTER-MACLEAY DRY SCLEROPHYLL FOREST (NSW 69)
(*) LHERMS - MU 16 - SPOTTED GUM - IRONBARK FOREST (OUTSIDE LHERMS AREA)
(*) CRA - TE 11 - IRONBARK

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: FL19 Assessor: ..... Date: 24/09/2008

Location: Wallaroo Nature Reserve (KP69.5) - to west of powerline easement

GPS Projection: Lat-Long: (UTM) Datum: (GDA94) WGS84; AGD84 Zone: 56

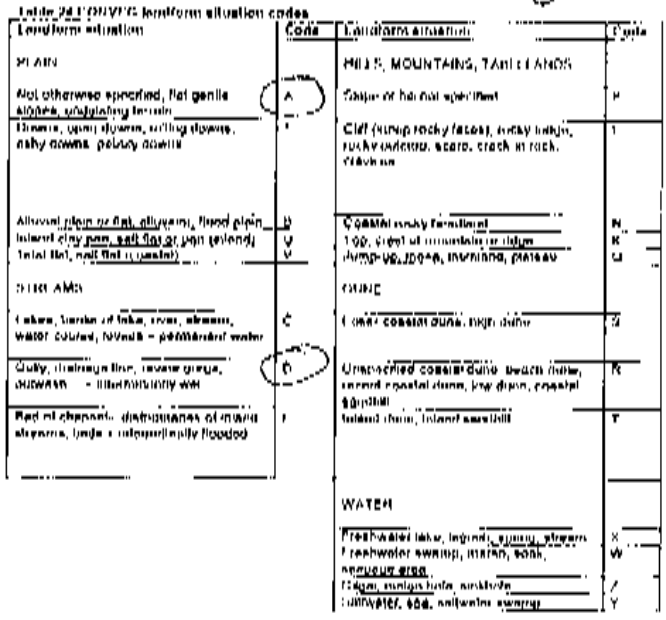
Latitude / Easting: 0385636 Longitude / Northing: 6390758 Waypoint #: 080

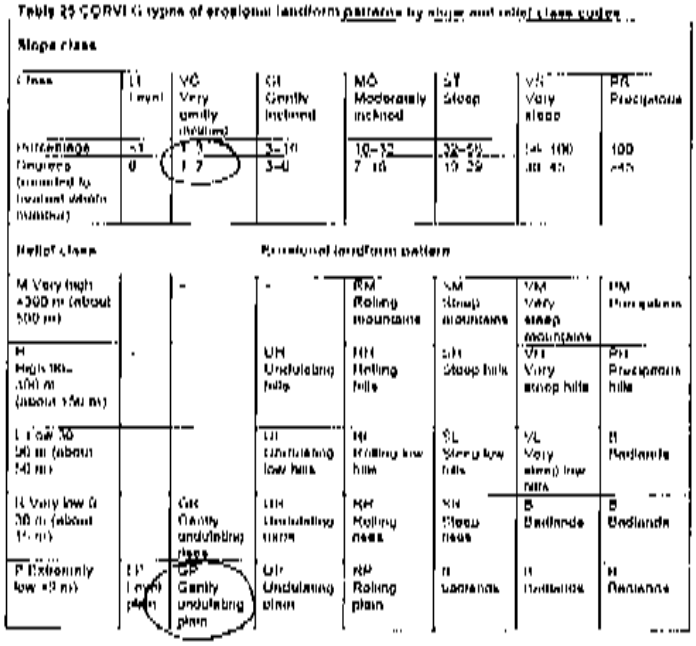
Photo: 2811 - 2813

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	
Pale	(Silty)	Silt	
Yellow	Sandy	Loam	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: 35m m Slope: ..... Aspect: N; NE; E; SE; S; SW; (W) NW

Landform: gently undulating plain ..... small drainage line





Disturbance

Fire scars: - %

Feral animal: - %

Weeds: ✓ %20

Other: some logging <%5 /

Health: Pristine / Excellent / Very Good / Good / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: -

Recreational: -

Conservation: possible rare veg type within area/connects to larger section

Commercial: of wallaroo nature reserve / remnant veg

Other Notes: confine pipeline construction to already cleared pipeline easement. Avoid clearing if possible W narrower strip than E

some trees 20-50cm (Blue gum)

Recognised as significant because veg/remnant - 2 to 4 20

Width of community: (<35m wide) ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha ?
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; (>50ha)

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	16	40%	
Mid	5	10%	
Ground	1	30%	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
C citriodora	A	T		16					
C umbra	A	T		16					
Angophora subvelutina	R	T		16					
E tereticornis	O	T		16					
Alphitonia excelsa	O	Sml T						2	
Bauchinia myrtifolia	A	Sml T				4			
Pittosporum undulatum (S)	A	Sml T				6			
Ficus coronata (climber, invasive)	O	Sml T					3.5		
Acacia irrorata	O	Sml T					3		
Melicope micrococca (Native Tobacco)	O	Sm T					3		
Lomandra hystrix	A	H					3		
Pandorea pandorana	O	Sh						1.5	
* Centella asiatica (Penny wort)	F	H							0.5
Selaria sp	F	Seed							0.1
Stephania japonica (Snake vine)	O	V							
Parsonia straminea (Monkey vine)	F	V							
Clematis aristata	F	V							
Cissus antarctica	A	V							
** Lantana camara	F	Sh						2	
* Verbena bonariensis	F	Sh						2	
* Gomphocarpus physocarpus (Balloon Bush)	F	Sh						1.5	
* Senecio madagascariensis	O	H							0.2

(*) Keith - NSW4 - Dry Rainforest

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; F = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

(*) HCCREMS - MU3 Hunter Valley Dry Rainforest (Outside LHCCREMS boundary)
(*) FE24 - Clarence Lowlands Spotted gum (Mapped as FE71)

Vegetation Monitoring Data Sheet

Job Number: S60665

Site Number: FL 20 Assessor: JB & CL Date: 05 / 07 / 2008

Location: KP 73 - JAMES - B/w Wellard & River

GPS Projection: Lat-Long (UTM) Datum: (GDA94); WGS84; AGD84 Zone: 56

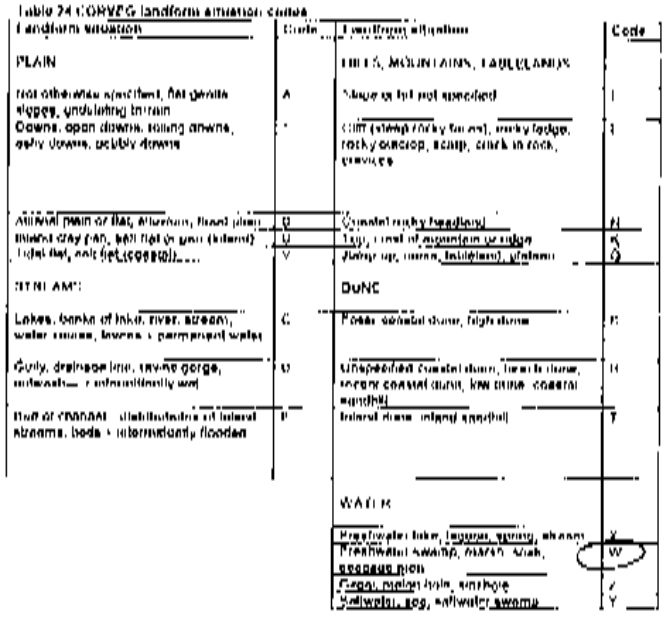
Latitude / Easting: 382 408 Longitude / Northing: 6389534 Waypoint #: 094

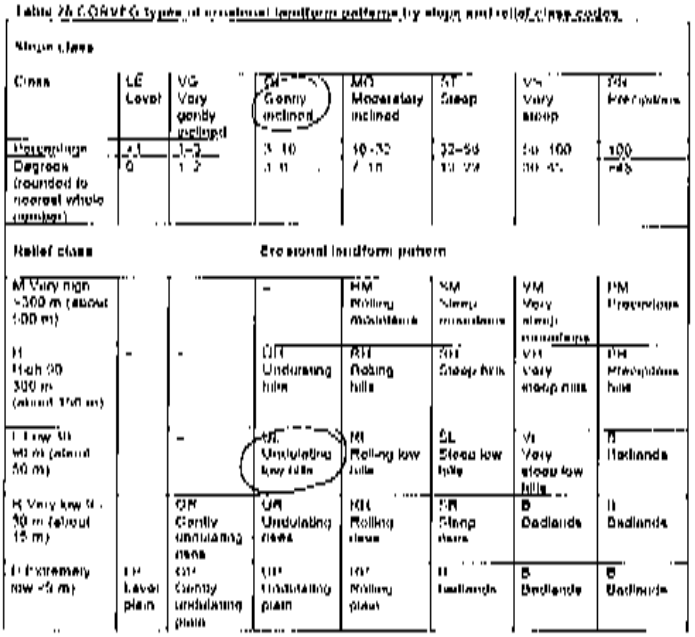
Photo: 2802 - 2864

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	* waterlogged
Pale	(Silty)	Silt	
Yellow	Sandy	Loam	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
Dark		Saline Mud	
Black			
Mottled			

Altitude: 6 m Slope: Aspect: N; NE; (E); SE; S; SW; W; NW

Landform: Swamp - western side





Disturbance

Fire scars: %

Feral animal: %

Weeds: ✓ (- maybe more - hyacinth) < 5 %

Other: cattle grazing %

Health: Pristine / Excellent / Very Good / Good / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: -

Recreational: -

Conservation: wetland natural - system of wetland environ

Commercial: -

Other Notes: Restrict pipeline construction to already cleared pasture lands west of wetland

* Melaleuca found in site is located in southern end (in other end canopy cover = 40%, none in N end)

Width of community: <35m wide ; 35-75m ; (75-150m) ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; (75-150m) ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; (1-5ha;) 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; (1-5ha;) 5-20ha ; 20-50ha ; >50ha

*

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent	5	<< 5	x open water in deeper parts of wetland
Canopy			
Mid			
Ground	1	70	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

	Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
	Melaleuca styphelioides	O	T	5						
	Casuarina glauca	O	T	6						
	Spirodella punctata (S) Duck Weed	F	A							
**	Eichhornia crassipes (S) water hyacinth	F	A							
	Juncus pallidus	A	Seed							1
	Carex appressa	A	Sed.							1
	Cynodon dactylon (grass)	A	G							
*	Senecio madagascariensis	F								0.2
	x Water plant (Potamogeton) (?) present, however dead so cannot be certain [it is a water plant]									
	* pass. burnt									

(*) LHCCREMS MU4b: Freshwater wetland complex (mapped as non-remnant)
(*) Keith – Coastal Freshwater Lagoons (56)
(*) FE – mapped as non-forest

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form; V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: FL 21 Assessor: JB1 CL Date: 04.09.2008

Location: Tea Tree Melaleuca Swamp - Hugh Property - KP75.7

GPS Projection: Lat-Long; (UTM) Datum: (GDA94) WGS84; AGD84 Zone: 56

Latitude / Easting: 0380834 Longitude / Northing: 6387347 Waypoint #: 92

Photo: 2838 - 2842

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	Clayey	(Clay)	waterlogged
Pale	(Silty)	Silt	
Yellow	Sandy	Loam	
Orange	Gravely	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: 12 m Slope: Aspect: N; NE; E; SE; S; SW; W; NW

Landform: Paperbark swamp

Table 24 CORVEG landform situation codes

Landform situation	Code	Landform situation	Code
PLAIN		HILLS, MOUNTAINS, TABLELANDS	
Not otherwise specified, flat gentle slopes, undulating terrain	A	Slope or hill not specified	F
Drowned, sunken dunes, rolling dunes, sandy downs, patchy dunes	*	Cliff (steep rocky mass), rocky ledge, rocky outcrop, scarp, crack in rock structure	L
Alluvial plain or flat, alluvium, floodplain	D	Coastal rocky headland	N
Inland clay pan, salt flat or pan (playa)	U	Top, crest of mountain or ridge	K
Tidal flat, salt flat (coastal)	V	Undulating, moss, tablerising, plateau	Q
STREAMS		DUNE	
Lakes, banks of lake, river, streams, water course, flowing = permanent water	C	Foredune, beach dune, high dune	H
Gully, drainage line, swamp gully, dambreak = intermittently wet	G	Unspecified coastal dune, beach dune, coastal sandhill dune, low dune, coastal hummock	K
Bed of channel—distributaries or inland streams, braids = intermittently flooded	F	Nebkha dune, inland sandhill	T
		WATER	
		Freshwater lake, lagoon, spring, stream	W2
		Freshwater swamp, marsh, soak, swampy plain	W
		Saltpan, saltmarsh, saltflats	S
		Saltwater, sea, saltwater swamp	Y

Table 25 CORVEG types of [illegible] landform patterns by slope and relief class codes

Slope class	LE Level	VG Very gently inclined	GE Gently inclined	MO Moderately inclined	ST Steep	VS Very steep	PM Precipitous
Percentage	0-1	1-2	3-10	10-32	32-56	56-100	100+
Degrees (rounded to nearest whole number)	0	1-2	3-5	6-18	18-30	30-45	45+

Relief class	Erosional landform pattern						
M Very high >300 m (about 900 m)				HM Rolling mountains	SM Steep mountains	VM Very steep mountains	PM Precipitous
H High (to 300 m (about 150 m))			UH Undulating hills	RH Rolling hills	SH Steep hills	VH Very steep hills	PH Precipitous hills
L Low (to 90 m (about 50 m))			UL Undulating low hills	RL Rolling low hills	SL Steep low hills	VL Very steep low hills	B Badlands
R Very low (to 30 m (about 15 m))		GR Gently undulating rises	(OR) Undulating rises	RR Rolling rises	SR Steep rises	B Badlands	B Badlands
P Extremely low <9 m)	LP Level plain	GP Gently undulating plain	UP Undulating plain	RP Rolling plain	U Hummocks	B Badlands	B Badlands

Disturbance

Fire scars: ✓ up to 4-5 % 50

Feral animal: X %

Weeds: X (Senecio cultivar pict on native vegetation) %

Other: cattle grazing %

Health: Pristine / Excellent / Very Good / Good / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural: -

Recreational: -

Conservation: Rare community within area

Commercial: -

Other Notes: Keep pipeline construction W of swamp to minimise clearing, hydrology & water quality impacts

If necessary, swamp to S can be crossed

Width of community: <35m wide ; (35-75m) ; 75-150m ; 150-300m ; >300 ; not linear
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; not linear
Total community area: Does not extend beyond site; <1ha ; (1-5ha) ; 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha

(*) Systems of wetlands along river.

50m X 10m Plot Information — Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	14	10	
Mid	3	10	
Ground	1	0 - 70 /	50 - allowance near water edge with at open water area at drier end

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

	Species	Rel. Dom.	Form	Ht (m) E	T1	T2	T3	S1	S2	G
	Melaleuca quinquenervia (5)	D	T		14					
	E. tereticornis	O	T		15					
	C. citriodora	O	T		15					
	Casuarina glauca	O	sm T		12					
*	Centella asiatica (hrmy wort)	O	H							O 1
	Carex appressa (s)	A	Sed						1	
	Pratia purpurascens (flower)	O	H							O
	Parsonia straminea (monkey vine)	F	V							

(*) L.HECREMS – MU 37 Swamp Mahogany - Paperbark Forest (Mapped as MU41)
(*) Keith - Coastal Swamp Forest
(*) FE142 - Swamp Mahogany / FE143 Swamp Oak (Mapped as FE143)

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent; T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine; E = Epiphyte; A = Aquatic; Seed = Seedling; Sap = Sapling;
Ab = Abundance within Stratum (D = dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Vegetation Monitoring Data Sheet Job Number: S60665

Site Number: FL22 Assessor: RM Date: 19 / 11 /2008

Location: Remnant Vegetation Near Woods Rd

GPS Projection: Lat-Long; (UTM) Datum: GDA94; (WGS84) AGD84 Zone: 56

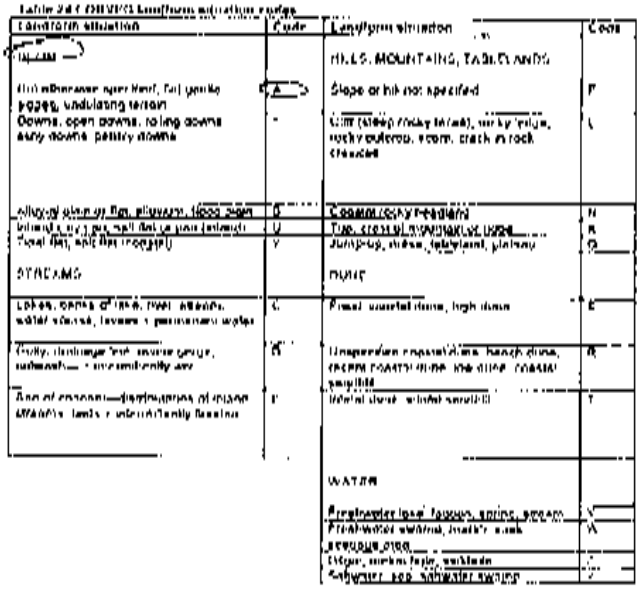
Latitude / Easting: 0399333 Longitude / Northing: 6442196 Waypoint #:

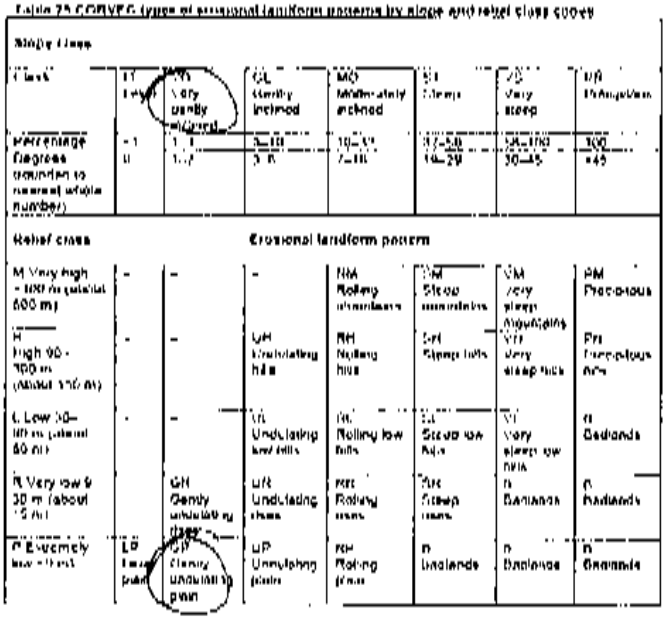
Photo: SL 3712561

Soil Colour	Soil Secondary Texture	Soil Primary Texture	Other Soil Notes
Whitish	(Clayey)	Clay	
Pale	Silty	(Silt)	
Yellow	Sandy	(Loam)	
Orange	Gravelly	Sand	
(Brown)	Stony	Gravel	
Red			
(Dark)		Saline Mud	
Black			
Mottled			

Altitude: 93 m Slope: Gentle Aspect: N (NE) E; SE; S; SW; W; NW

Landform:





Disturbance

Fire scars: %

Feral animal: %

Weeds: %

Other: %

Health: Pristine / Excellent / (Very Good) / Good / Average / Degraded / Completely Degraded (almost without natives)

Special significance

Cultural:

Recreational:

Conservation:

Commercial:

Other Notes:

Width of community: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 ; (not linear)
Width of total remnant: <35m wide ; 35-75m ; 75-150m ; 150-300m ; >300 , not linear
Total community area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha
Total remnant area: Does not extend beyond site; <1ha ; 1-5ha; 5-20ha ; 20-50ha ; >50ha

50m X 10m Plot Information

Canopy Stratum Form: Tree; Shrub; Herb; Grass; Aquatic

Stratum	Median Height (m)	Visual Cover Est (%)	Other Structural Notes
Emergent			
Canopy	20m	10%	-> 95% grass cover
Mid	-	-	-> 5% bare ground.
Ground	0.5m	<1%	

All woody species present within 50m x 10m plot (plus dominant and threatened non-woody species)

Species	Rel. Dom.	Form	Ht (m). E	T1	T2	T3	S1	S2	G
Eucalyptus propinqua	A	TREE			15m				
Eucalyptus siderophloia	D	TREE		20m					
Eucalyptus paniculata	A	TREE			15m				
Eucalyptus Umbra	A	TREE		20m					
Pultenea villosa	O/F	SHRUB					0.5m		
Acacia ulicifolia	O	SHRUB						0.5m	
* NOTE 4 possible habitat trees within vicinity of plot									
(*) KEITH - REGROWTH									
(*) CRA - REGROWTH									

Species annotations: S = Specimen Collected; * = Exotic Species; ** = Declared Species; + = Outside but adjoining 50m x 10m plot
Height categories: E = Emergent, T1 = Tree 1 stratum, T2 = Tree 2, T3 = Tree 3, S1 = Shrub 1 stratum, S2 = Shrub 2, G = Ground stratum
Form: V = Vine, F = Epiphyte; A = Aquatic, Seed = Seedling; Sap = Sapling.
Ab = Abundance within Stratum (D = Dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare)

Appendix B

Habitat Assessment Data Sheets

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HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT: SL0066503 Lucas Cranes DATE: 29-8-08

SITE NO: 2001 LOCATION: Large Remnant 1 NAME: LdG/DR

AMG: 56H EASTING: 0 4 0 3 6 2 b NORTHING: 6 4 4 9 2 1 0

DISTANCE and DIRECTION from TOWN: SITE IS 5km km (s) NE (N, S, E, W,) OF Stratford IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 153m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type: open Eucalypt forest

RE: ---- VEG: FA LANDFORM: A.A

SOIL: silty loam

LANDSCAPE

Shape of patch?

☑ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☑ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi isolated

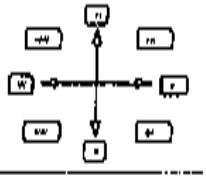
☐ C-Not isolated ☑ D-Continuous tree / shrub

■ Continuous tree/shrub cover ☐ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☑ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☑ two or three species

☐ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: E. propinqua ① E. racemosa ② E. siderophloia ③

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☑ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☑ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Exocarpus cupressiformis

Low shrub cover (0.5 m – 2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Corrosperma sp. Acacia ulicifolia, Pultenaea sp.

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☑ Bare-dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☑ Other Other remnant veteb

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☑ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☑ dead ☐ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☑ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☐ Absent (0) ☑ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☑ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☑ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

no large hollow bearing trees.
Stumps indicating historical logging

WETLANDS

Wetlands present?

☐ YES ☑ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

remnant patch surrounded by cleared grazing land.

Photo: · 101-0236 (koala scratches)
· 101-0237 (facing SE)

Grey gums w. recent + historical scratches 4x50m walked - 18 trees noted.

Scats S01-S04 collected

SITE NO. 2001

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT s6066503 Lucas Energy DATE 29-8-08

SITE NO. 7.002 LOCATION Large Remnant 2 NAME DR/LdG

AMG 56H EASTING 0403129 NORTHING 6448541

DISTANCE and DIRECTION from TOWN: SITE IS 4km km (s) NE (N. S. E. W.) OF Stratford IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 129m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type open Eucalypt forest

RE — VEG FA LANDFORM PLA

SOIL silty loam

LANDSCAPE

Shape of patch?

☑ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➧ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☑ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

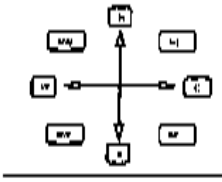
☐ C-Not Isolated ☑ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁝⁝ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☑ Flat ☐ Ridge ☐ Gully ☑ Slope drainage lines

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☑ two or three species

☐ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: E. moluccana① C. canea① E. sideroxylon①

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☐ 10-15 m ☑ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☑ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Eucalyptus expressiformas

Low shrub cover (0.5 m - 2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Acacia ulicifolia Bursaria spinosa Cassinia sp

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☑ ~~Bare dirt / rocks~~ / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☑ Other Other remnant patch.

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☑ Abundant (>10)

If present, are they mostly? ☑ dead ☑ living

Fallen trees or branches present 10-30 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☑ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☑ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☑ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Rock dependent fauna

☑ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☑ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

some historical thinning of trees.

European Hare

Superb. Fairy wrens

WETLANDS

Wetlands present?

☐ YES ☑ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

remnant patch continuous w. 2.001 surrounded by cleared grazing land.

Photo: 101-0238 (facing S)

echidna diggings. noted within greater area

Scat SOS

scratches not noted on koala preferred trees (4x50m walked).

SITE NO. 2.002

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066503 Lucas Energy DATE 29-8-08

SITE NO. 2003 LOCATION Avon R + Dog Trap Ck NAME DR + LdG

AMG 56H EASTING 0401948 NORTHING 6449280

DISTANCE and DIRECTION from TOWN: SITE IS 4km km (s) NNE (N. S. E. W.) OF Stratford IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 108 m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type: riparian remnant

RC: VEG: MK LANDFORM: GIC

SOIL: silty sand

LANDSCAPE

Shape of patch?

☐ Circular / square ☐ Irregular ☑ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☑ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width: 30-40m

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☑ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

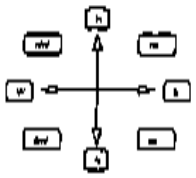
☐ C-Not Isolated ☑ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☑ Flat ☐ Ridge ☐ Gully ☑ Slope watercourse

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☑ two or three species

☐ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: Angophora subvelutina ② Casuarina cunninghamiana

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☑ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☑ more than three species

Are shrubs mostly?

☑ native ☑ exotic

Species: Acacia implexa ⑧ Solanum mauritianum exotic Mel / Callistemon sp. ⑧ Ligustrum sinense

Low shrub cover (0.5 m – 2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☑ exotic

Species: Hymenanthera dentata ⑧ Solanum mauritianum

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass ~~Herbs~~

☐ Low Heath ☐ Weeds ☑ Bare dirt / ~~rocks / litter~~

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☑ Cattle

☐ Crops Crop type:

☐ Other Other:

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☑ Abundant (>10)

If present, are they mostly? ☐ dead ☑ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☑ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☑ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☑ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Rock dependent fauna

☑ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS: heard frogs

cattle access to water evident

herbs/shrubs heavily grazed

Magpies, cattle, egret, grey fantail, white bowed ~~rabbit~~ warren ? (photo: 101 - 0240) rabbit

eastern + crimson rosellas, noisy miners, grey butcherbird purple swamphen

WETLANDS

Wetlands present?

☑ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☑ Creek ➡ ☐ Dry ☑ Flowing (just)

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☑ 8-100 ha ☐ >100 ha

➡ Water mostly

☑ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☑ Islands for birds to roost and nest

☑ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

erosion + exposed banks

Photo: 101 - 0241 (facing N)

101 - 0242 (facing S)

riparian vegetation limited to main channel width - not extending into pasture

some peach trees

SITE NO. 2003

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 56066503 Lucas Energy DATE 30-8-08

SITE NO. 2004 LOCATION KP27 Karuah River gully (N) NAME DR / LdG

AMG 56 H EASTING 0397560 NORTHING 6421469

DISTANCE and DIRECTION from TOWN: SITE IS 4km km (s) NNW (N, S, E, W.) OF Gloucester IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 58m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Gully remnant

RE VEG FW LANDFORM GUL

SOIL sandy clay

LANDSCAPE

Shape of patch?

☐ Circular / square ☐ Irregular ☐ Strip <50 m

☑ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☑ Other Gully

Width 50m

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☑ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

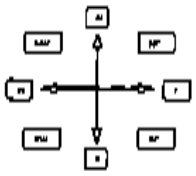
☐ C-Not Isolated ☑ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☐ Flat ☐ Ridge ☑ Gully ☐ Slope

If slope, give aspect over 20 m



40° N

Degrees of slope over 20 m:

25° S

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☑ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: E. carnea E. siderophloia Alphitonia excelsa Melaleuca styphelioides

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☑ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☑ more than three species

Are shrubs mostly?

☑ native ☑ exotic

Species: Solanum mauritianum Senna acclemis Hibiscus heterophyllus Notelaea sp.

Low shrub cover (0.5 m – 2 m):

☐ Absent ☐ Scattered ☑ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☐ native ☑ exotic

Species: Lantana camera

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass / herbs

☐ Low Heath ☐ Woods ☐ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☑ Other Other remnant w cattle N + S

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☑ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☑ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☑ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☑ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☑ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10-30 cm diameter?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

limited to creek bed.

Surface rocks of > 30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☑ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☑ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

grey fantail, bell bird (heard), yellow thornbill, large billed scrubwren, brown cuckoo dove, kookaburra, swift

bandicoot foraging pits (photo: 101-0246)

WETLANDS

Wetlands present?

☑ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND: but vegetated

☐ Creek ➡ ☑ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☑ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☑ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Photo: facing W 101-0245

creek E of proposed alignment (Carnoah F

presence of *datyrus* advised by landholder ∴ HDD suggested

vegetated gully w continuous groundcove (lantana common + w raspberry)

connects ridge to W with creek to E.

steep slopes W of Telstra cable

sediment control critical

GPS-005 (photo: 101-0247)

0397574 6421617 Zone 56

SITE NO. 2.004

well-used by koala / possum - no scats

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 36066503 Lucas Energy DATE 30-8-08

SITE NO. 2005 LOCATION KP10 near reserved sanctuary NAME LdG/DR

AMG 56 11 EASTING 093 968 969 NORTHING 6544044

DISTANCE and DIRECTION from TOWN: SITE IS 6km km (s) SSE (N. S. E. W.) OF Stratford IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 149m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type open eucalypt forest

RE ---- VEG FA LANDFORM DDE

SOIL Sandy silt

LANDSCAPE

Shape of patch?

☐ Circular / square ☐ Irregular ☑ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☑ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width 40m

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☑ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

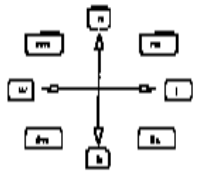
☑ C-Not Isolated ☐ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☑ Flat ☐ Ridge ☐ Gully ☑ Slope v. slight

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☑ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: Corymbia citriodora ① E. sideroxylon ② E. camaldulensis ③ Allocasuarina torulosa

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☐ 10-15 m ☑ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Melaleuca linariifolia A. irrorata

Low shrub cover (0.5 m – 2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Bursaria spinosa Acacia ulicifolia Leucopogon juniperinus Comospermum sp

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass / herbs

☐ Low Heath ☐ Woods ☑ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☑ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☑ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☑ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☑ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☐ Absent (0) ☑ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☑ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☑ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Rock dependent fauna

☑ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☑ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

white winged chough, grey crowned babbler.
noisy miner, galah
rabbit warren w 5-6 holes.
rabbit
no koala scratchings observed

WETLANDS

Wetlands present?

☑ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☑ Creek ➡ ☑ Dry ☐ Flowing some ponded sections.

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Photo: 101-0248 (facing W)

Drainage line E-ward w. cattle grazing throughout + cleared pasture N + S
Reserved sanctuary located directly adjacent E
small powerline corridor on fenceline
drainage line not fenced off for cattle
banks undercut + erosion evident
historic logging within remnant

SITE NO 2005

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066503 Iluka Energy DATE 30-8-08

SITE NO. 2006 LOCATION KP14.4 NAME LD6/DR

AMG 6 6 H EASTING 0 3 9 4 5 5 NORTHING 6 4 3 4 3 5 8

DISTANCE and DIRECTION from TOWN: SITE IS 10.2km km (s) SSW (N. S. E. W.) OF Stratford IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 86m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type riparian remnant

RE VEG MK LANDFORM STC

SOIL Sandy clay

LANDSCAPE

Shape of patch?

☐ Circular / square ☐ Irregular ☑ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☑ Creek / river ☐ Roadside

☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☑ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

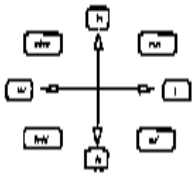
☐ C-Not Isolated ☑ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☑ Flat ☐ Ridge ☐ Gully ☑ Slope drainage depression

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☑ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: Melaleuca sp E. melucenna E. leucoxylon M linearifolius Angophora subvelutina

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☑ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Grevillia sp Notelaea sp

Low shrub cover (0.5 m – 2 m):

☐ Absent ☐ Scattered ☐ Common ☐ Abundant

If shrubs present:

☑ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Grevillia sp

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☑ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☑ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☑ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☑ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☑ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☑ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☑ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

limited to creek bed

Surface rocks of > 30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☑ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☑ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

noisy friarbird
crimson rosella

cattle access to water evident
hooved frogs

④ large Angophora subvelutina @ GPS 006 56H 0399492 hill 6343
↳ important habitat to maintain (photo: 101-0251)
(also 5 of creek bends →)

WETLANDS

Wetlands present?

☑ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☑ Creek ➡ ☐ Dry ☑ Flowing ? possibly pooled

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☑ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☑ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Erosion + exposed banks

bends in channel E of survey site (photo: 101-0252) with roots + bank collapse evident

channel straight - preferred crossing directly E of powerline

riparian vegetation generally limited to main channel width - little extension into pasture

Photo: 101-0250 (facing W)

SITE NO. 2006

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066503 Lucas Energy DATE 31-8-08

SITE NO 2007B LOCATION KP37 Black Camp Rd. NAME LdG / DR

AMG 56H EASTING 039636 NORTHING 6414300

DISTANCE and DIRECTION from TOWN: SITE IS 7 km km (s) SSW (N. S. E. W.) OF Stroud Road. IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 105 m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type open Eucalypt forest

RE VEG FA LANDFORM 11SL

SOIL Sandy clay

LANDSCAPE

Shape of patch?

☑ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☑ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

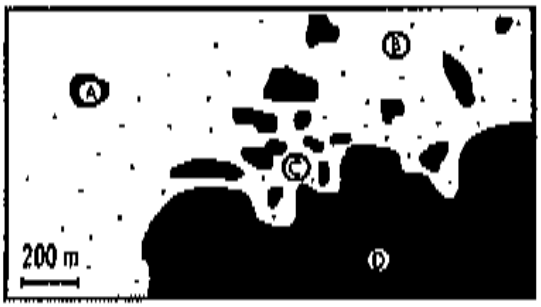
☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not Isolated ☑ D-Continuous tree / shrub

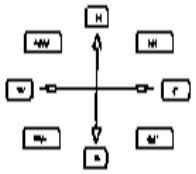
■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☐ Flat ☐ Ridge ☐ Gully ☑ Slope

If slope, give aspect over 20 m



SSW

Degrees of slope over 20 m: 26°

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☑ two or three species

☐ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: E. camaldulensis Corymbia citriodora E. sideroxylon

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☑ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☑ two or three species

☐ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Melaleuca styphelioides Bursaria spinosa Allocasuarina torulosa Jacksonia scoparia

Low shrub cover (0.5 m – 2 m):

☐ Absent ☐ Scattered ☑ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☑ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Bursaria spinosa Leucopogon juniperinus Acacia inoryata A. ulicifolia Pultenea sp.

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☑ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☐ Other Other remnant patch

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☑ Abundant (>10)

If present, are they mostly? ☐ dead ☑ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☐ Common (10-20) ☑ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☐ Absent (0) ☑ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☑ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10-30 cm diameter?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☑ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☐ Poor ☐ Average ☐ Good ☑ Excellent

Rock dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☐ Good ☑ Excellent

OTHER HABITAT QUALITY ASPECTS:

red necked wallaby on approach from N
kookaburra, magpie, swallow
eastern yellow robin
partridge diggings
scratchings not evident (some old marks)
heard frogs.

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Raining - heavy at times
photo: 101-0252 (facing W)
vegetation more mature W than E
proposed pipeline within road reserve
large ironbarks + spotted gums present + preservation recommended (101-0254)
area susceptible to erosion + gullying (101-0253)
suggestion for pipeline E/uphill of current road reserve where vegetation is more juvenile/disturbed/ thinned

SITE NO: 2007B

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066903 Lucas Energy DATE 31-8-08

SITE NO. 2008 WS01 LOCATION KP24.2 Kawuah River crossing NAME DR/LdG

AMG 5 6 H EASTING 0 3 9 8 2 3 7 NORTHING 6 4 7 7 3 9 1

DISTANCE and DIRECTION from TOWN: SITE IS 1.82 km (s) NNW (N. S. E. W.) OF Stroud Road IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 42m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☑ Native grasses (trees / shrubs may be present)

☑ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type riparian remnant

RE ---- VEG MK LANDFORM STC

SOIL clay - sand

LANDSCAPE

Shape of patch?

☐ Circular / square ☐ Irregular ☐ Strip <50 m

☑ Strip >50 m

➡ Strip details: ☑ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width 30m

Area of full patch that contains 1 ha area:

☐ < 3 ha ☑ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

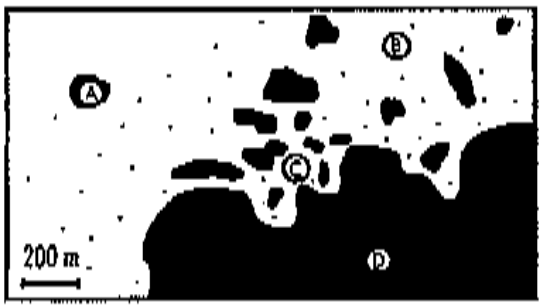
☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not Isolated ☑ D-Continuous tree / shrub

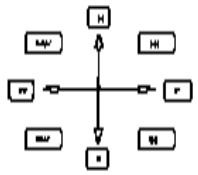
■ Continuous tree/shrub cover ⁚⁚ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☑ Flat ☐ Ridge ☐ Gully ☑ Slope watercourse

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☑ two or three species

☐ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: E. tereticornis Syzygium sp. Corymbia cunninghamiana

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☐ 10-15 m ☑ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☑ more than three species

Are shrubs mostly?

☑ native ☑ exotic

Species: Corkwood w. white flower *Peach Trisloniopsis laurina

Low shrub cover (0.5 m – 2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☑ more than three species

Are shrubs mostly?

☑ native ☐ exotic

Species: Acacia sp. Pittosporum sp. Ageratina sp. Elaeodendrum australi

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☑ Continuous grass / herbs

☐ Low Heath ☐ Woods ☑ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☑ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☑ Abundant (>10)

If present, are they mostly? ☐ dead ☑ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☐ Common (10-20) ☑ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☑ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☑ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☐ Absent ☐ Scattered ☐ Common ☑ Abundant

Surface rocks of > 30 cm diameter?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Rock dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☑ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS: lewings honeyeater
Mistletoe bird, Yellow robin, grey fantail, galah
access to NW bank - E. leptophleba not possible to search for scratchings
* likely platypus habitat

WETLANDS

Wetlands present?

☑ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☑ Flowing

☑ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemoral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☑ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☑ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☑ Fencing to exclude grazing stock from direct access to the waters edge South (unknown on NW)

☑ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

high banks w. exposed sections + erosion evident
large trees (incl. E. leptophleba) within river channel + on upper banks

suggestion to utilize HDD to reduce habitat disturbance + bank erosion / collapse

photo: 101-0257 (facing NW)
101-0259 (facing NE)

assessment conducted from SE side of river

SITE NO: ZOOR(WSOI)

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066503 Lucas Energy DATE 31-8-08

SITE NO. Z009 LOCATION KP25 Karuah River crossing NAME DR/LDG

AMG 56 H EASTING 0 3 9 7 4 1 2 NORTHING 6 4 2 6 4 1 5

DISTANCE and DIRECTION from TOWN: SITE IS 19.6 km (s) S (N. S. E. W.) OF Stratford IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☑ WGS 84 or GDA ALTITUDE 60m

GENERAL

☑ Remnant trees ☐ Regrowth ☐ Plantation

☐ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type riparian remnant

RE VEG MK LANDFORM STC

SOIL Sandy clay

LANDSCAPE

Shape of patch?

☐ Circular / square ☐ Irregular ☑ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☑ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width 45m

Area of full patch that contains 1 ha area:

☐ < 3 ha ☑ 3-10 ha ☐ 11-30 ha ☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

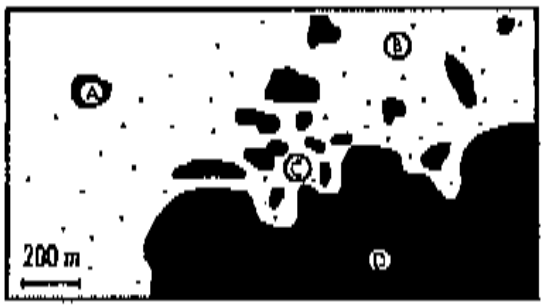
Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☑ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated ☐ C-Not Isolated ☑ D-Continuous tree / shrub

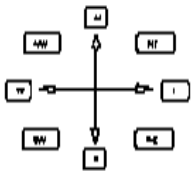
■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☑ Flat ☐ Ridge ☐ Gully ☑ Slope watercourse

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☑ Open ☐ Dense

If trees present:

☐ single tree species

☑ two or three species

☐ more than three species

Are trees mostly?

☑ native ☐ exotic

Species: E. moluccana? Casuarina cunninghamiana Syzygium sp

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☑ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☑ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☑ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☐ Scattered ☑ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☑ more than three species

Are shrubs mostly?

☐ native ☑ exotic

Species: Tristaniopsis laurina Melia Azedarach Laurel sp. Glochidion sp. Melaleuca sp *Peach *Solanum mauritianum

Low shrub cover (0.5 m – 2 m):

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

If shrubs present:

☑ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly?

☐ native ☑ exotic

Species? *Ligustrium sinense

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☐ Continuous grass / herbs

☐ Low Heath ☐ Woods ☑ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☑ Cattle

☐ Crops Crop type

☑ Other Other horses

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☑ Abundant (>10)

If present, are they mostly? ☐ dead ☑ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☐ Common (10-20) ☑ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☐ Absent (0) ☑ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☑ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10-30 cm diameter?

☐ Absent ☑ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☑ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☑ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☐ Poor ☑ Average ☐ Good ☐ Excellent

Rock dependent fauna

☑ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☑ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☑ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

*likely platypus habitat

ring parrot, horses

WETLANDS

Wetlands present?

☑ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☑ Flowing

☑ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☑ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☑ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☑ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

several large *E. leucoxylon* in area

suggestion to utilise IDD to reduce habitat disturbance + bank erosion

assessment conducted from NE side of river

photo: 101-0264 (facing NW)

large log placed (+ secured w. chain) across river (photo: 101-0265)

SITE NO. 2009

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 56066 S03 Lucas Energy DATE 1/7/09

SITE NO. Z010 LOCATION KP 3.7 buffer. NAME L.G, D.R.

AMG 56H EASTING 400733 NORTHING 6445479

DISTANCE and DIRECTION from TOWN: SITE IS 1km km (s) ESE (N. S. E. W.) OF Stratford IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or (GDA) ALTITUDE 131.3m

GENERAL

☒ Remnant trees ☐ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Open eucalypt forest

RE — VEG FW LANDFORM PLA

SOIL loamy clay.

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☒ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

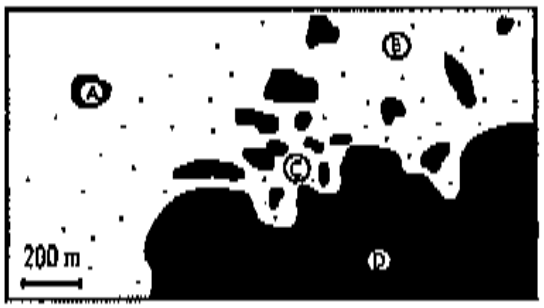
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not isolated ☒ D-Continuous tree / shrub

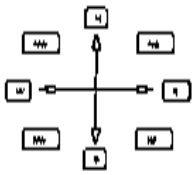
■ Continuous tree/shrub cover ▦ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☒ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☒ more than three species

Are trees mostly?

☐ native ☐ exotic

Species: E. bicolor (1) E. fasciculosa / viminalis (2) E. sideroxylon (3)

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☐ 10-15 m ☒ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☒ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Mel. sp. native cherry

Low shrub cover (0.5 m – 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☒ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Bursaria spinosa Pultenaea Acacia ulicifolia

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☒ Continuous grass / ~~herbs~~

☐ Low Heath ☐ Weeds ☒ ~~Bare dirt / rocks~~ / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☒ dead ☐ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☒ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

Eastern grey kangaroo

White-throated treecreeper and Red-browed finch in gullies area

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Scratches on few smooth-bark trees.

101-0266 photo South facing

Area cleared to the East where proposed pipe alignment is to be placed.

Area logged historically, no big trees in the area.

SITE NO 2010

7 of 21

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S60666503 Lucas Energy DATE 1/9/09

SITE NO. ZOII LOCATION KP21 NAME L.G.D.R.

AMG 56 H EASTING 398402 NORTHING 6430147

DISTANCE and DIRECTION from TOWN: SITE IS 4.68 km (s) SSW (N. S. E. W.) OF Wards River IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 134m

GENERAL

☒ Remnant trees ☐ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☒ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Open Eucalypt forest

RE — VEG EW LANDFORM HSL

SOIL loamy clay

LANDSCAPE

Shape of patch?

☐ Circular / square ☒ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☒ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

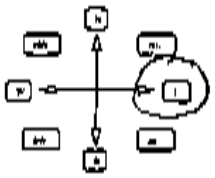
☐ C-Not Isolated ☒ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⊡ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☐ Flat ☐ Ridge ☐ Gully ☒ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m: 5-10°

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☒ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: E. propinqua (1) C. punctata (2) E. siderophloia (3) C. citriodora (4) (maculata)

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Lantana Syzygium

Low shrub cover (0.5 m – 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☒ exotic

Species: Lantana E. cyperifolium

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☒ Continuous grass / herbs

☐ Low Heath ☐ Woods ☐ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☒ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☒ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☒ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

Site Photos

little bee activity (not seen)

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

regrowth

Remnant bush at both side of powerline.
Approx 10m space between powerline (West) and forest.
Area historically grazed with four to five trees which should be kept.
01-02/11 ph-2 (clear)

SITE NO. 7011

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 5606650? Lucas Energy DATE 1/9/08

SITE NO. Z012 LOCATION KP49.5 Black Camp Rd ginchi. NAME L.G, D.R.

AMG 54H EASTING 291353 NORTHING 6407948

DISTANCE and DIRECTION from TOWN: SITE IS 12km km (s) SE (N. S. E. W.) OF Dungeora IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 53m

GENERAL

☒ Remnant trees ☐ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Open eucalypt forest

RE VEG FW LANDFORM PLA

SOIL loamy

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☒ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

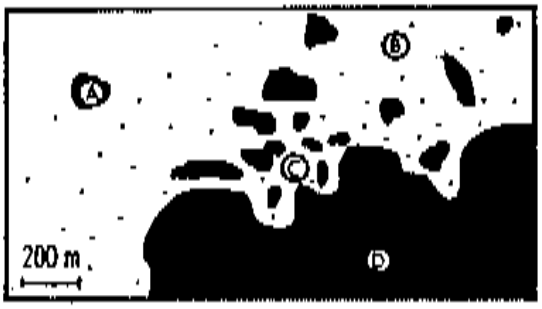
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not Isolated ☒ D-Continuous tree / shrub

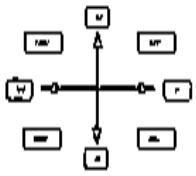
■ Continuous tree/shrub cover ▭ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☒ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☒ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: E. sideraphloia ① C. maculata ①
E. acmenioides ② C. citriodora ①

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☐ Scattered ☒ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☒ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: M. nodosa Corymbia sp.
Acacia implexa

Low shrub cover (0.5 m – 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☒ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Acacia longifolia
Pultenaea sp. Exocarpos cupressiformis

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☒ Continuous grass / herbs

☐ Low Heath ☐ Woods ☒ Bare dirt / rocks / litter

LAND USE

Used for? Around

☐ Mixed grazing ☐ Sheep ☒ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☒ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☒ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10-30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

spotted turtle dove

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemoral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Remnant patch close to the creek. Approximately 20 m from remnant patch to the creek. Some regrowth in between that could be removed. Allow buffer between trench and creek.

SITE NO. 2012

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 56066503 Lucas Energy DATE 2/9/08

SITE NO. 2013 QR3 LOCATION K-P40 Black Canyon Road NAME L.G. D.R.

AMG 56H EASTING 396061 NORTHING 6412313

DISTANCE and DIRECTION from TOWN: SITE IS 10km km (s) SSW (N. S. E. W.) OF Stroud Road IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 193.2m

GENERAL

☒ Remnant trees ☐ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Open eucalypt forest

RE — VEG FW LANDFORM HSL

SOIL Clay

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➧ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☒ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

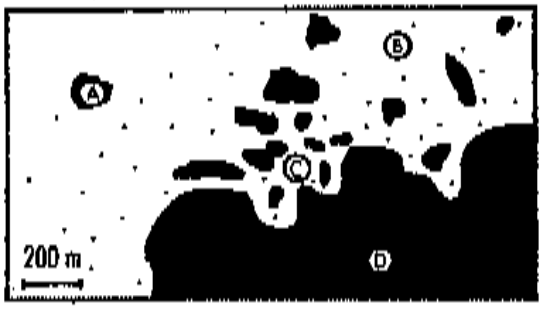
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not isolated ☒ D-Continuous tree / shrub

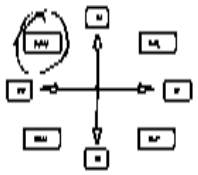
■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☐ Flat ☒ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m: 40-45°

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☒ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: E. crebra (1) E. populnea (1) E. cambageana (1) E. melanophloia (1) A. harpullioides

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: A. victoriae
A. leiopoda

Low shrub cover (0.5 m - 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: D. viridiflorum
A. leiopoda

Dominant ground cover within this 1 ha area:

☒ Tussocks ☐ Hummocks ☐ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☒ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☒ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☑ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☒ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☒ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☒ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☒ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Historical logging.

Vegetation is consistent over the whole area. Slope gets steeper towards the gully

Photo 101-0275 SW aspect

(RLR3)

SITE NO. 2013

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066503 Lucas Energy DATE 2/9/08

SITE NO. 20146 LOCATION BCRD KP41 Black Canyon Road NAME L.G., D.R

AMG 56H EASTING 395208 NORTHING 6411529

DISTANCE and DIRECTION from TOWN: SITE IS 11 km km (s) SSW (N, S, E, W,) OF Stroud Road IN NSW (state)

WAS GPS USED? ☑ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 79 m

GENERAL

☒ Remnant trees ☒ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☒ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Open eucalypt forest

RE — VEG FW LANDFORM F00

SOIL Sandy Clay

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☒ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

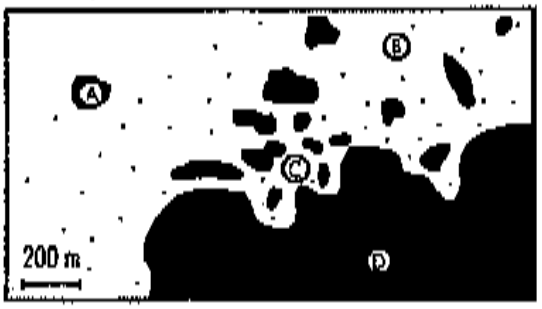
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not Isolated ☒ D-Continuous tree / shrub

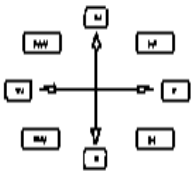
■ Continuous tree/shrub cover ⁚⁚ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☒ Flat ☐ Ridge ☒ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☒ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: E. propinqua (Gray gum) E. melliodora E. microcarpa (Grey box) E. tereticornis

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☐ 10-15 m ☒ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☒ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Acacia spp, Ficia cornuta A. ancistrocarpa Dianella revoluta

Low shrub cover (0.5 m – 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☒ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Melaleuca nodosa M. thymifolia Hibiscus sp. Correspondens

Dominant ground cover within this 1 ha area:

☒ Tussocks ☐ Hummocks ☒ Continuous grass / ~~herbs~~

☐ Low Heath ☐ Woods ☒ ~~Bare dirt / rocks~~ / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☐ Scattered (1-5) ☒ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☒ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☐ Scattered (1-10) ☐ Common (10-20) ☒ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☐ Patchy ☒ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☒ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☒ Excellent

OTHER HABITAT QUALITY ASPECTS:

Above the beginning of a corridor. Area of high significance for fauna through migration.

red necked wallaby, grey crowned babbler

WETLANDS

Wetlands present?

☒ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☒ Creek ➡ ☐ Dry ☒ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☒ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☒ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT small creek

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Remnant patch 5-10 m of a creek and powerlines. Steep short bank, gravelly bed outlet on left of road from S-N view. Some cleared forest on left.

Dirt tracks on grey ground.

Photo 101-0261 NE, creek side.

(ACRO)

SITE NO. 20148

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 96066 503 Jurassic Energy DATE 3/9/09

SITE NO. Z-015 LOCATION KP56-5 (Smith) NAME LG, DR

AMG 56H EASTING 390394 NORTHING 6401435

DISTANCE and DIRECTION from TOWN: SITE IS 9km km (s) NE (N. S. E. W.) OF Clarence Town IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 72 m

GENERAL

☒ Remnant trees ☒ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☒ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type

RE VEG MK LANDFORM Gul

SOIL Clay soil

LANDSCAPE

Shape of patch?

☐ Circular / square ☐ Irregular ☒ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☒ Creek / river ☐ Roadside

☐ Windbreak ☐ Other

Width ~50

Area of full patch that contains 1 ha area:

☐ < 3 ha ☒ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

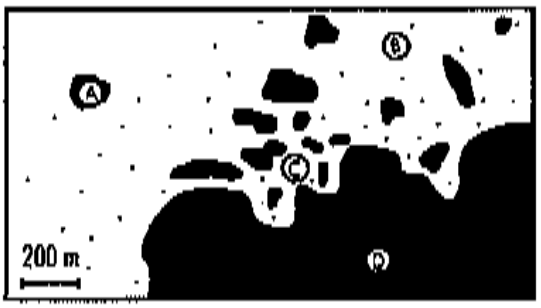
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not Isolated ☒ D-Continuous tree / shrub

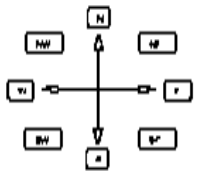
■ Continuous tree/shrub cover ⁙ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☐ Flat ☐ Ridge ☒ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☐ Open ☒ Dense

If trees present:

☐ single tree species

☒ two or three species

☐ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: Eucalyptus sp. Syzygium sp. Melaleuca sp.

Average height of overstory?

☐ 3-5 m ☒ 5-10 m ☐ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☐ Scattered ☒ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☒ exotic

Species: Saplings Melaleuca sp. Lantana

Low shrub cover (0.5 m – 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☒ exotic

Species: Notelaea Rubus sp. Lidsporium Passiflora spinosa

Dominant ground cover within this 1 ha area:

☒ Tussocks ☐ Hummocks ☐ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☐ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☒ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☐ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☒ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☐ Absent ☐ Scattered ☒ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☒ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☒ Excellent

OTHER HABITAT QUALITY ASPECTS:

2 Rabbits

WETLANDS

Wetlands present?

☒ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☒ Creek ➡ ☒ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemoral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☒ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☒ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Gully with cattle pastures at both sides.
Recognised corridor in the area.
Photo: 101-0281 & 101-0282 (facing SE)

SITE NO: 2015

HLA 16 of 21

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066503 Lucas Energy DATE 3/9/08

SITE NO. 2016 LOCATION KP61.5 Reserve NAME L.G, D.P.

AMG 56H EASTING 389909 NORTHING 6396441

DISTANCE and DIRECTION from TOWN: SITE IS 19.3 km (s) S,SE (N, S, E, W.) OF Durgoo IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 49 m

GENERAL

☒ Remnant trees ☒ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Open Eucalypt forest

RE 5 VEG FW LANDFORM PLA

SOIL Sandy loam

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside

☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☒ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

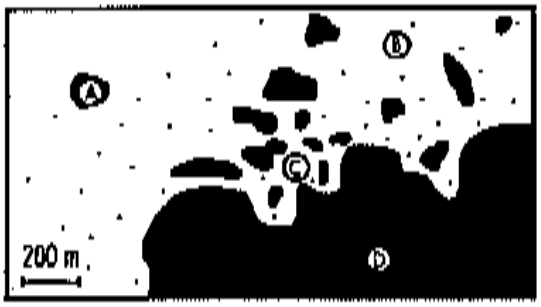
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi isolated

☐ C-Not isolated ☒ D-Continuous tree / shrub

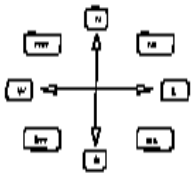
■ Continuous tree/shrub cover ⁙ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☒ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☒ two or three species

☐ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: Casuarina cristata ① E. sideroxylon ② E. socialis ③

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☐ Scattered ☐ Common ☒ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Melaleuca nesophila Banksia spinulosa Leptospermum sp.

Low shrub cover (0.5 m – 2 m):

☐ Absent ☐ Scattered ☒ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Acacia ulicifolia Leucopogon Pultenaea sp.

Dominant ground cover within this 1 ha area:

☒ Tussocks ☐ Hummocks ☐ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☐ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☒ Other Other Remnant Conservation

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☐ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (5-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☒ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

Young remnant forest

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemoral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Remnant forest very isolated.
Conservation reserve.

Photos:
101-0283 SE
101-0284

SITE NO. Z016

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 5h0b502 Lucas Sp. nov. DATE 3/19/09

SITE NO. Z017 LOCATION KP65.4 powerline easement NAME L6, DR

AMG 56H EASTING 385509 NORTHING 6393733

DISTANCE and DIRECTION from TOWN: SITE IS 1.2km km (s) S (N, S, E, W.) OF Clarence Town IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 340 m

GENERAL

☒ Remnant trees ☐ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Open eucalypt forest

RE - VEG FW LANDFORM PLA

SOIL Sandy Clay

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside

☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☒ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

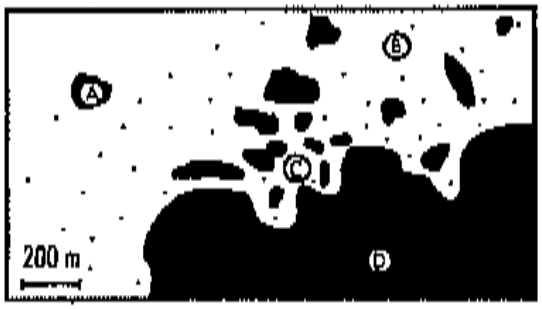
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not Isolated ☒ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☒ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m

Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☒ two or three species

☐ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: E. siderophloia ①
E. tereticornis ①

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: E. umbelliformis
Leptospermum sp.

Low shrub cover (0.5 m – 2 m):

☐ Absent ☐ Scattered ☒ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Xanthorrhoea sp.
Pultenaea sp.

Dominant ground cover within this 1 ha area:

☒ Tussocks ☐ Hummocks ☐ Continuous grass / herbs

☐ Low Heath ☐ Woods ☐ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☒ Other Other Remnant w Powerline Corridor

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☐ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☒ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☒ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

Raining
Frog calls

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemoral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Photo
101-0285 facing SW
No evidence of ice on bank
Swamps indicative high rainfall

SITE NO. 2017

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S 6066503 Lucas average | DATE 4/9/08

SITE NO. ZO18 | LOCATION KP 66.8 Wallaroo Nature Reserve | NAME L.G, D.R.

AMG 56 H | EASTING 384536 | NORTHING 6392487

DISTANCE and DIRECTION from TOWN: SITE IS 1.8 km (s) SE (N. S. E. W.) OF Charlestown | IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO | IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA | ALTITUDE 25 m

GENERAL

☒ Remnant trees ☒ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type: Open eucalypt forest

RE: ——— | VEG: FW | LANDFORM: PLA

SOIL: Clay Loam

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☒ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

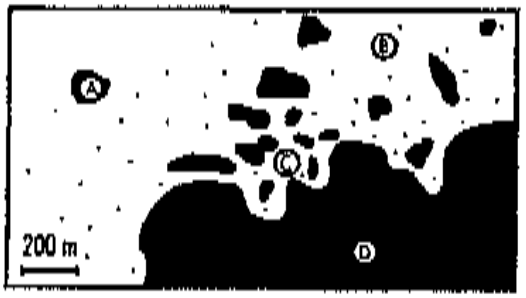
☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☐ C-Not Isolated ☒ D-Continuous tree / shrub

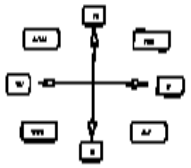
■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☒ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☒ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: Corymbia citriodora D
E. siderophloia D

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☐ Absent ☐ Scattered ☐ Common ☒ Abundant

If shrubs present:

☒ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Melaleuca nodosa

Low shrub cover (0.5 m – 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species: Banksia spinulosa Acacia linearis Pultenaea sp.

Dominant ground cover within this 1 ha area:

☒ Tussocks ☐ Hummocks ☐ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☒ ~~Bare dirt / rocks~~ / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☒ Other Other: Nature reserve

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☒ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☒ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

Frog calls

WETLANDS

Wetlands present?

☐ YES ☒ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☐ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Photo 101-0293 NW of habitat

101-0291 Powerline easement SW

Wallaroo Nature reserve

Habitat assessment adjacent to the powerline easement West, close to road.

Young remnant with few large trees, logs and logs.

SITE NO. 2018

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT 2006503 Tuna Energy DATE 4/9/08

SITE NO. L019 LOCATION KP 68.9 Wallaroo Nature Reserve NAME L.G., D.R.

AMG 5 6 4 EASTING 3 8 5 6 3 1 NORTHING 6 3 9 0 2 5 1

DISTANCE and DIRECTION from TOWN: SITE IS 3.2km km (s) SSE (N, S, E, W,) OF Clarence Town IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 21m

GENERAL

☒ Remnant trees ☒ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☒ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Rocky forest

RE — VEG EW LANDFORM GUL

SOIL

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width

Area of full patch that contains 1 ha area:

☐ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☒ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

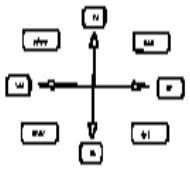
☐ C-Not Isolated ☒ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁚ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☐ Flat ☐ Ridge ☒ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☐ Sparse ☒ Open ☐ Dense

If trees present:

☐ single tree species

☐ two or three species

☐ more than three species

Are trees mostly?

☒ native ☐ exotic

Species: E. acmenoides ◎ C. citriodora ◎

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understorey shrub cover (>2 m):

☐ Absent ☐ Scattered ☒ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☒ more than three species

Are shrubs mostly?

☒ native ☒ exotic

Species: Acacia sp. Lantana

Low shrub cover (0.5 m – 2 m):

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☒ two or three species

☐ more than three species

Are shrubs mostly?

☒ native ☐ exotic

Species:

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☒ Continuous grass / ~~herbs~~

☐ Low Heath ☐ Weeds ☒ ~~Bare dirt / rocks~~ / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☐ Cattle

☐ Crops Crop type

☒ Other Other Nature Reserve

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☐ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☐ Sparse ☒ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10-30 cm diameter?

☐ Absent ☒ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☐ Average ☒ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

Young remnant forest with few large trees, stags and logs. frog calls

WETLANDS

Wetlands present?

☒ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☒ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong, pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☐ Wooded swamp

☐ Gilgai ☐ Claypan

☒ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☒ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☒ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☐ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☐ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☐ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Several drainage gullies perpendicular to the powerline.

101-0300 East Photos
0301 West

SITE NO. 2019

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT: S0066502 Lucas Energy | DATE: 4/9/08

SITE NO: ZO20 WIND7 | LOCATION: KP 75.5 Wetland NE Williams River | NAME: L.G., D.A.

AMG: 56H | EASTING: 380819 | NORTHING: 6387331

DISTANCE and DIRECTION from TOWN: SITE IS 8 km (s) SW (N, S, E, W.) OF Queanbeyan IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO | IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA | ALTITUDE 10 m

GENERAL

☒ Remnant trees ☒ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☐ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type: Wetland

RE: | VEG: FE | LANDFORM: SWP

SOIL: clay loam

LANDSCAPE

Shape of patch?

☒ Circular / square ☐ Irregular ☐ Strip <50 m

☐ Strip >50 m

➡ Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☐ Other

Width:

Area of full patch that contains 1 ha area:

☐ < 3 ha ☒ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

☒ YES ☐ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

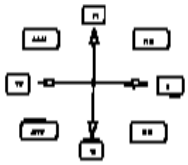
☒ C-Not isolated ☐ D-Continuous tree / shrub

■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland

Is this 1 ha area on a:

☒ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☒ Sparse ☐ Open ☐ Dense

If trees present:

☐ single tree species

☒ two or three species

☐ more than three species

Are trees mostly? ☒ native ☐ exotic

Species: Melaleuca quinquenervia ① E. tereticornis ② C. gummifera ③

Average height of overstory?

☐ 3-5 m ☐ 5-10 m ☒ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly? ☐ native ☐ exotic

Species:

Low shrub cover (0.5 m – 2 m):

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly? ☐ native ☐ exotic

Species:

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☒ Continuous grass / herbs

☐ Low Heath ☐ Weeds ☐ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☒ Cattle

☐ Crops Crop type:

☐ Other Other:

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☒ living

Fallen trees or branches present 10-50 cm diameter?

☐ Absent (0) ☒ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☐ Absent ☒ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS: Weather: Raining

Frog calls

To minimise disturbance deviat west of powerline + paperbark swamp, or HDD preferable to utilise existing clearings.

WETLANDS

Wetlands present?

☒ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (all)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☒ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemeral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☐ < 2 ha ☒ 2-8 ha ☐ 8-100 ha ☐ >100 ha

➡ Water mostly

☒ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☒ Broad, shallow, swampy areas for birds to feed

☒ Islands for birds to roost and nest

☒ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☒ Dense tree and / or shrub cover close to the edge of the water

ADDITIONAL NOTES:

Wetland surrounded by grazing pasture. Some remnant tree cleared sparse forest. Trees in the wetland removed for powerline and telecommunications easement.

Photo 101-0308 SW

101-0309 SE

SITE NO. 2020

HLA

HABITAT ASSESSMENT FOR 1 ha SEARCH AREA

PROJECT S6066503 Lucas Extn DATE 5/9/08

SITE NO. Z-021 LOCATION KP 77.6 Wetland E Williams River NAME L.G, D.R.

AMG 56H EASTING 382462 NORTHING 6389629

DISTANCE and DIRECTION from TOWN: SITE IS 5.3 km (s) SW (N. S. E. W.) OF Clarencetown IN NSW (state)

WAS GPS USED? ☒ YES ☐ NO IF YES, WHICH DATUM WAS USED? ☐ Aust (84/66) ☒ WGS 84 or GDA ALTITUDE 5 mm

GENERAL

☒ Remnant trees ☐ Regrowth ☐ Plantation

☒ Native grasses (trees / shrubs may be present)

☒ Non-native grasses (trees / shrubs may be present)

☐ Improved pasture ☐ Other

Habitat type Wetland

RE — VEG FE LANDFORM SWP

SOIL Clay loam

LANDSCAPE

Shape of patch?

☐ Circular / square ☒ Irregular ☐ Strip <50 m

☐ Strip >50 m

Strip details: ☐ Creek / river ☐ Roadside ☐ Windbreak ☒ Other Wetland

Width

Area of full patch that contains 1 ha area:

☒ < 3 ha ☐ 3-10 ha ☐ 11-30 ha

☐ 31-100 ha ☐ 101-400 ha ☐ > 400 ha

Is the 1 ha patch connected to other similar sized or larger patches of vegetation?

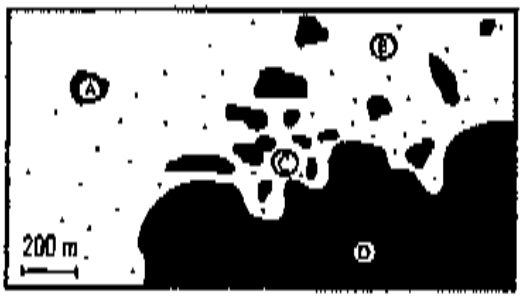
☐ YES ☒ NO

Position of this 1 ha search area relative to the surrounding tree / shrub cover?

☐ A- Isolated ☐ B-Semi Isolated

☒ C-Not Isolated ☐ D-Continuous tree / shrub

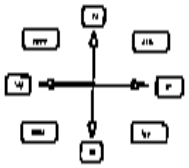
■ Continuous tree/shrub cover ⁘ Scattered trees ☐ Grassland



Is this 1 ha area on a:

☒ Flat ☐ Ridge ☐ Gully ☐ Slope

If slope, give aspect over 20 m



Degrees of slope over 20 m:

VEGETATION STRUCTURE : OVERSTORY

Tree canopy cover (trees taller that 3 m):

☐ Absent ☒ Sparse ☐ Open ☐ Dense

If trees present:

☐ single tree species

☒ two or three species

☐ more than three species

Are trees mostly? ☒ native ☐ exotic

Species: Melaleuca stypheloides Casuarina glauca

Average height of overstory?

☐ 3-5 m ☒ 5-10 m ☐ 10-15 m ☐ > 15 m

Are the trees?

☐ Even-aged (Trees mostly the same age or size)

☒ Multi-aged (Trees of varing size or age)

Are there obvious signs of dieback in the tree canopy?

☐ None ☒ Some dieback ☐ Extensive dieback

VEGETATION STRUCTURE : UNDERSTORY

Tall understory shrub cover (>2 m):

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly? ☐ native ☐ exotic

Species:

Low shrub cover (0.5 m - 2 m):

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If shrubs present:

☐ single shrub species

☐ two or three species

☐ more than three species

Are shrubs mostly? ☐ native ☐ exotic

Species:

Dominant ground cover within this 1 ha area:

☐ Tussocks ☐ Hummocks ☒ Continuous grass Sedges ☐ Herbs

☐ Low Heath ☐ Woods ☐ Bare dirt / rocks / litter

LAND USE

Used for?

☐ Mixed grazing ☐ Sheep ☒ Cattle

☐ Crops Crop type

☐ Other Other

HLA

HABITAT ASSESSMENT (*cont.*)

KEY HABITAT FEATURES

HOLLOWS and LOGS

No. of hollows within 1 ha patch?

☐ Absent (0) ☒ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

If present, are they mostly? ☐ dead ☐ living

Fallen trees or branches present 10-50 cm diameter?

☒ Absent (0) ☐ Scattered (1-10) ☐ Common (10-20) ☐ Abundant (> 20)

Fallen trees or branches present >50 cm diameter?

☒ Absent (0) ☐ Scattered (1-5) ☐ Common (6-10) ☐ Abundant (>10)

Leaf litter?

☒ Absent ☐ Sparse ☐ Patchy ☐ Dense

Mistletoe within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

ROCKS

Outcrops within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of 10–30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Surface rocks of > 30 cm diameter?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

Cliffs and overhangs within this 1 ha area?

☒ Absent ☐ Scattered ☐ Common ☐ Abundant

If present, are they mostly?

☐ Sandstone ☐ Granite

☐ Basalt ☐ Karst

☐ Other [ ]

CRACKING CLAY SOILS

☐ YES ☒ NO

HABITAT QUALITY FOR:

Hollow dependent fauna

☐ Absent ☒ Poor ☐ Average ☐ Good ☐ Excellent

Rock dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Log dependent fauna

☒ Absent ☐ Poor ☐ Average ☐ Good ☐ Excellent

Small birds

☐ Absent ☐ Poor ☒ Average ☐ Good ☐ Excellent

OTHER HABITAT QUALITY ASPECTS:

Frog calls
Waterfowl

WETLANDS

Wetlands present?

☒ YES ☐ NO

TYPE OF WETLAND:

MARINE:

☐ Coral reef ☐ Rocky shore ☐ Beach (All)

☐ Estuarine ☐ Tidal mudflat ☐ Tidal marsh

☐ Tidal forest (e.g. mangrove) ☐ Lagoon

☐ Saline / brackish lake / swamp

INLAND WETLAND:

☐ Creek ➡ ☐ Dry ☐ Flowing

☐ River ☐ Floodplain, river flat

☐ Small billabong , pools (<8 ha) ☐ Freshwater lake (>8 ha)

☐ Shrubby swamp ☒ Wooded swamp

☐ Gilgai ☐ Claypan

☐ Ephemoral Marsh / swamp with emergent veg

ARTIFICIAL WETLANDS:

☐ Large dam, reservoir (>8 ha) ☐ Small dam, pond, tank

☐ Irrigation channel, rice field ☐ Wastewater treatment

☐ Canal, drainage channel, ditch ☐ Salt pond / field

AREA OF WETLAND:

☒ < 2 ha ☐ 2-8 ha ☐ 8-100 ha ☐ >100 ha

Water mostly

☒ Fresh ☐ Brackish / saline ☐ Salty

FEATURES PRESENT

☒ Broad, shallow, swampy areas for birds to feed

☐ Islands for birds to roost and nest

☒ Dead or living trees in the water (partly submerged) for roosting and nesting habitat

☐ Fencing to exclude grazing stock from direct access to the waters edge

☒ ~~Trees~~ tree and / or shrub cover close to the edge of the water ➡ patchy

ADDITIONAL NOTES:

Photo 101-0310 S GPS WLND 10
101-0311 E WLND 9

→ ( ) S

Small creek connecting wetland within 093 upstream ↙

water hyacinth

SITE NO. 2021

Appendix C

Fauna Observations from the Field Investigation

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Scientific Name	Common Name	Location(s)	Fauna Observation Site(s)	Comments
Birds				
Acanthiza nana	Yellow Thornbill	KP27	Z004	
Alisterus scapularis	Australian King-Parrot	KP25	Z009	
Bubulcus ibis	Cattle Egret	Avon R/DTpCk	Z003	
Chenonetta jubata	Australian Wood duck	KP29.2, KP67.1, KP76.2	Z008, DAM1, WLND3	
Corcorax melanorhamphos	White-winged Chough	KP10	Z005	
Cormobates leucophaea	White-throated Treecreeper	KP3.7	Z010	
Cracticus torquatus	Grey Butcherbird	Avon R/DTpCk	Z003	
Dacelo novaeguineae	Laughing Kookaburra	KP21, KP27, KP37, KP76.2	Z011, Z004, Z007B, WLND3	
Eolophus roseicapilla	Galah	KP10, KP29.2, KP76.2	Z005, Z008, WLND3	
Eopsaltria australis	Eastern Yellow Robin	KP29.2, KP37	Z008, Z007B	
Gallinula tenebrosa	Dusky Moorhen	KP76.2	WLND3	
Gymnorhina tibicen	Australian Magpie	Avon R/DTpCk, KP37	Z003, Z007B	
Hirundo neoxena	Welcome Swallow	KP27, KP37, KP76.2	Z004, Z007B, WLND3	
Larus novaehollandiae	Silver Gull	KP97.4	WLND14	
Macropygia amboinensis	Brown Cuckoo-Dove	KP27, KP76.2	Z004, WLND3	
Malurus cyaneus	Superb Fairy-wren	Lge Rem2	Z002	
Manorina melanocephala	Noisy Miner	Avon R/DTpCk, KP10	Z003, Z005	
Manorina melanophrys	Bell Miner	KP27	Z004	heard
Meliphaga lewinii	Lewin's Honeyeater	KP29.2	Z008	
Neochmia temporalis	Red-browed Finch	KP3.7	Z010	
Pelecanus conspicillatus	Australian Pelican	KP76.2	WLND3	

Scientific Name	Common Name	Location(s)	Fauna Observation Site(s)	Comments
Philemon corniculatus	Noisy Friarbird	KP14.4	Z006	
Platalea regia	Royal Spoonbill	KP91.7	WLND12	
Platycercus elegans	Crimson Rosella	Avon R/DTpCk, KP14.4, KP76.2	Z003, Z006, WLND3	
Platycercus adscitus	Eastern Rosella	Avon R/DTpCk, KP76.2	Z003, WLND3	
Podargus strigoides	Tawny Frogmouth	Lge Rem1, KP40	NIGHT1, NIGHT2	
Pomatostomus temporalis	Grey-crowned Babbler	KP 4, KP 36.9, KP 39.5	Z005, Z014B, OB54	
Porphyrio porphyrio	Purple Swamphen	Avon R/DTpCk	Z003	
Rhipidura albiscapa	Grey Fantail	Avon R/DTpCk, KP27, KP29.2	Z003, Z004, Z008	
Rhipidura leucophrys	Willie Wagtail	KP76.2, KP97.4	WLND3, WLND14	
Sericornis frontalis	White-browed Scrubwren	Avon R/DTpCk	Z003	
Sericornis magnirostra	Large-billed Scrubwren	KP27	Z004	
* *Streptopelia chinensis*	Spotted Turtle-Dove	KP49.5	Z012	
Threskiornis molucca	Australian White Ibis	Lge Rem1, KP97.4	NIGHT1, WLND14	
Reptiles				
Physignathus lesueurii	Water Dragon	KP76.2	WLND3	
Pogona barbarta	Bearded Dragon	KP19	BDRAG	
Frogs				
-	-	KP97.4	WLND14	no frogs heard
-	-	Avon R/DTpCk, KP14.4, KP37, KP65.4, KP66.8, KP67.1, KP68.9, KP72.6, KP75.5	Z003, Z006, Z007B, Z018, DAM1, Z019, Z021, Z020	frogs heard – no ID
Litoria ewingii	Brown Tree Frog	Lge Rem1	NIGHT1	

Scientific Name	Common Name	Location(s)	Fauna Observation Site(s)	Comments
Mammals				
-	-	Lge Rem2	Z002	Echidna diggings in wider area
-	-	KP25, KP27, KP29.2	Z009, Z004, Z008	Platypus reported in Karuah River
-	-	Avon R/DTpCk, KP10	Z003, Z005	Rabbit warren
-	-	KP27	Z004	Bandicoot foraging pits
-	-	KP37	Z007B	Macropod diggings
* *Lepus capensis*	European Hare	Lge Rem2	Z002	
Macropus giganteus	Eastern Grey Kangaroo	KP3.7	Z010	
Macropus rufogriseus	Red Necked Wallaby	KP33, KP34.2, KP41.1	Z007B, NIGHT2, Z0014B	
* *Oryctolagus cuniculus*	European Rabbit	KP10, KP56.5	Z005, Z015	
Trichosurus vulpecula	Brushtail Possum	Lge Rem1	NIGHT1	

***** = exotic (human-assisted) introduction.

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Appendix D

Legislation Relevant to Ecological Aspects of the Proposed Development

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D.1 Commonwealth Legislation

D.1.1 Environment Protection and Biodiversity Conservation Act (1999)

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) regulates Matters of National Environmental Significance, including the following matters:

- threatened species and ecological communities listed on the schedules of the Act
- National Heritage Places
- Ramsar wetlands
- Commonwealth Marine Areas
- migratory species
- World Heritage Properties
- Nuclear actions
- Actions on Commonwealth land
- Actions taken by the Commonwealth Government.

There are no World Heritage Properties, Commonwealth land or Commonwealth marine properties in the project area. Nuclear actions and actions taken by the Commonwealth are of no relevance to this proposed development.

The southern end of the pipeline lies about 1 km upstream of the Hunter Estuary Wetlands, which is listed as a RAMSAR wetland. Provided appropriate mitigation measures as proposed in this report are followed, the proposed development is very unlikely to have any significant impacts on this wetland.

The proposed development does not contain any protected ecological communities. The pipeline transects one population of Small-flower Grevillea (*Grevillea parviflora* subsp*. parviflora*) listed as Vulnerable under the EPBC Act. The study area contains potential habitat for a further 9 nationally threatened flora species and 10 fauna species. Potential impacts on flora and fauna of conservation significance are assessed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (**Table T15**, **Table T16).** The project was referred to DEWHA on 29 August 2008 (EPBC 2008/4432) and was considered to be a controlled action, as it is likely to have a significant impact on the following matters protected under the EPBC Act:

- The project involves disturbance of acid sulfate soils which have the potential to change the physio-chemical status of the RAMSAR-listed Hunter Estuary Wetlands
- The project potentially involves the disturbance of breeding populations of nationally threatened frogs including the Booroolong frog (*Litoria booroolongensis*) and the giant barred frog (*Mixophyes iteratus*).
- The present survey has also recorded a population of the nationally threatened Small-flower Grevillea (*Grevillea parviflora* subsp*. parviflora*) in a powerline easement at KP 65.5.

DEWHA has decided that the project will need to be assessed through state assessment under a bilateral agreement. It will include a public consultation phase and will require approval by the Minister for the Environment, Water, Heritage and the Arts.

A total of 21 species of birds listed as Marine and / or Migratory under the EPBC Act were considered to potentially occur in the study area, or for have potential habitat within the study area. The potential impacts to these species were assessed following the 'significant impact criteria' as outlined in the *EPBC Act Policy Statement 1.1, Significant Impact Guidelines* (DEH 2006).

D.2 State Legislation

D.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) and the EP&A Regulations provide the framework for environmental planning in NSW and include provisions to ensure that proposals which have the potential to impact the environment are subject to detailed assessment and provide opportunity for public involvement.

This project has already been declared to be a major infrastructure development under Part 3a of the EP&A Act. Therefore, approval for the project is required under Part 3A of the EP&A Act, and the Minister for Planning is the approval authority for the proposed works.

Under Section 75U of the EP&A Act, the following authorisations (among others) are not required for an approved project (i.e. permission to carry out these activities is granted as part of the approval):

- the concurrence under Part 3 of the Coastal Protection Act 1979 of the Minister administering that Part of the Act
- a permit under section 201, 205 or 219 of the Fisheries Management Act 1994
- an approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977
- a permit under section 87 or a consent under section 90 of the National Parks and Wildlife Act 1974
- an authorisation referred to in section 12 of the Native Vegetation Act 2003 (or under any Act to be repealed by that Act) to clear native vegetation or State protected land
- a permit under Part 3A of the Rivers and Foreshores Improvement Act 1948
- a bush fire safety authority under section 100B of the Rural Fires Act 1997
- a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the Water Management Act 2000.

Under section 75JA of the EP&A Act, the proponent may be required to acquire and retire (in accordance with Part 7A of the *Threatened Species Conservation Act* 1995) biodiversity credits to offset any impacts to biodiversity values potentially arising from a major project.

D.2.2 Native Vegetation Act 2003

Clearing remnant native vegetation or protected regrowth generally requires approval under the Native Vegetation Act 2003 (NV Act) unless the clearing is a permitted activity. Remnant vegetation is defined under the NV Act (for this part of NSW) as being all native vegetation that was in existence on 1 January 1990. However, the NV Act does not apply to any clearing that is, or that is part of, a designated development within the meaning of the EP&A Act and for which development consent has been granted under that Act.

D.2.3 Threatened Species Conservation Act 1995 (TSC Act)

A separate license under the *Threatened Species Conservation Act* 1995 (TSC Act) can be required for clearing approved as part of a Development Consent. In most situations permitted activities can be undertaken without requiring a threatened species approval (i.e. "it is a defence to a prosecution for an offence against Section 118A of the TSC Act if the action was essential for the carrying out of development in accordance with a development consent within the meaning of the EP&A Act"). However, as some permitted activities do require consideration of threatened species, further advice should be sought from the local Catchment Management Authority.

The pipeline transects one population of small-flower grevillea (*Grevillea parviflora* subsp*. parviflora*) listed as Vulnerable under the TSC Act. The study area contains potential habitat for a further 14 flora and 47 fauna species protected under the Act.

D.2.4 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act* 1974 (NPW Act) provides for the establishment, preservation and management of national parks, historic sites and certain other areas and the protection of certain fauna, native plants and Aboriginal objects.

The Act allows for the reservation of land as a national park to protect and conserve areas containing outstanding or representative ecosystems, natural or cultural features or landscapes or phenomena. National parks are managed for numerous values, including:

- the conservation of biodiversity, the maintenance of ecosystem functions, the protection of geological and geomorphological features and natural phenomena and the maintenance of natural landscapes
- the conservation of places, objects, features and landscapes of cultural value
- the protection of the ecological integrity of one or more ecosystems for present and future generations
- the promotion of public appreciation and understanding of the national park's natural and cultural values.

Mining activities are not permitted in a national park or historic site, except as expressly authorised by an Act of Parliament. The *Mining Act* 1992, the *Offshore Minerals Act* 1999, the *Petroleum (Onshore) Act* 1991 and the *Petroleum (Offshore) Act* 1982 do not apply to lands within a national park or historic site.

Under Section 153, the Minister may grant easements or rights of way through, upon or in a national park, historic site, state conservation area, regional park, nature reserve or karst conservation reserve for the construction of pipelines, or for the erection of standards, posts, wires and appliances for the conveyance or transmission of electricity, or for any other purpose deemed necessary.

The proposed pipeline transects Wallaroo National Park from KP 59.7 to KP 63, following an existing electricity easement.

D.2.5 State Environmental Planning Policy 14 – Coastal Wetlands Protection (SEPP 14)

This policy aims to ensure that coastal wetlands are preserved and protected in the environmental and economic interests of the State. Clearing, filling, draining or constructing a levee on a SEPP 14 wetland requires consent of the council and the concurrence of the Director-General of the Department of Infrastructure, Planning and Natural Resources. However, the concurrence of the Director-General is not required for development that is declared to be a project under Part 3A of the EP&A Act.

The proposed pipeline transects one SEPP14 wetland for approximately 30 m at KP 68.9 and lies adjacent to several other SEPP 14 wetlands at KP 86 and KP 88.

D.2.6 State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44)

The *State Environmental Planning Policy No 44--Koala Habitat Protection* aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. It identifies local government areas and tree species that are known to support koalas, encourages the identification of areas of core koala habitat and requires the preparation of plans of management for areas identified as core koala habitat before development consent can be granted.

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline, by:

- requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat
- encouraging the identification of areas of core koala habitat
- encouraging the inclusion of areas of core koala habitat in environment protection.

All six local government areas in which the project occurs (Dungog, Gloucester, Great Lakes, Maitland, New Castle and Port Stephens) are listed in Schedule 1 of SEPP 44. As such, all of the project area is in areas covered by SEPP 44.

Under the SEPP, "potential koala habitat" means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. Three of the species listed in Schedule 2 were recorded in the project area: forest red gum (*Euc. tereticornis*), tallowwood (*Euc*. *mycrocorys*) and grey gum (*Euc*. *punctata*), but mostly at low densities. Two areas of the ecological community south coast shrubby grey gum contained grey gum in densities of 15 % or greater, making theses locations “potential koala habitat”. These were a 0.7 km section of woodland along the proposed pipeline route between KP 14.6 and KP 15.25 and a 0.4 km section between KP 36.4 and KP 36.8.

Under the SEPP, "core koala habitat" means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings and historical records of a population. Evidence of a resident koala population was not found within the project area. Due to the small amount of "potential koala habitat" in the project area, it seems unlikely that an area of "core koala habitat" occurs in the project area. However, targeted surveys for koalas were hindered during the present field survey due to time constraints and inclement weather conditions.

D.2.7 Port Stephens Council Comprehensive Koala Plan of Management

The *Port Stephens Council Comprehensive Koala Plan of Management* (Port Stephens Council 2002; CKPoM*)* was prepared under SEPP 44, in close consultation with the NSW NPWS. Its purpose is to establish a management framework for Koalas and their habitat in the port Stephens LGA.

The principal objectives of the CKPoM are to:

- Evaluate and rank Koala habitat throughout the Port Stephens LGA.
- Identify priority conservation areas and strategies to protect significant Koala habitat and populations.
- Identify threats that impact on Koalas and Koala habitat.
- Provide for the long-term survival of Koala populations by devising conservation strategies to effectively address each of the threats impacting on Koalas and Koala habitat.
- Provide for the restoration of degraded Koala habitat areas.
- Ensure that adequate detail is provided with Development Applications in order to assess, minimise and ameliorate likely impacts on Koala habitat.
- Provide guidelines and development standards to protect Koalas and Koala habitat.
- Provide for effective public awareness and education programs concerning Koala conservation issues.
- Encourage appropriate eco-tourism programs.
- Provide a formal approach for the assessment, retrieval, rehabilitation and release of sick, injured, orphaned or distressed Koalas.
- Identify potential funding sources for implementation of the CKPoM.
- Facilitate targeted Koala conservation and management-oriented research projects within the Port Stephens LGA.
- Provide for the effective implementation and monitoring of the CKPoM.

The identification of koala habitat within the Port Stephens LGA involved a combination of field-based survey and community-based survey data, interpreted in the context of a detailed vegetation map. The resulting combined Koala Habitat Map identified and ranked Koala habitat as *Preferred*, *Supplementary* and *Marginal*. From this combined map, a Koala Habitat Planning Map was prepared. The Koala Habitat Planning Map provides the basis for identifying the areas that are considered to warrant the highest level of habitat protection. These areas include all Preferred Koala Habitat and Habitat Buffers. Supplementary Koala Habitat and Habitat Linking Areas also require protection. The CKPoM Consultative Committee recommended that the width of Habitat Buffers should be determined on a case-by-case basis using ecological criteria. These ecological criteria are detailed in Appendix 9 of the CKPoM.

With regard to the proposed Gas Pipeline project:

- Protection of Koala habitat is relevant during the construction period.
- Managing the Risk of Bushfires is relevant during the construction period and during maintenance of the RoW.
- Consideration of Koala Welfare is relevant during the construction period.

The other major aspects of the CKPoM (Habitat Restoration; Traffic Management; Dog Management; Feral Animal Management; Education; and Tourism) are not directly relevant to the proposed Gas Pipeline project.

D.2.8 State Environmental Planning Policy 71 – Coastal Protection (SEPP 71)

This policy aims to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast.

This policy applies to land within 100 m of any of the following:

- mean high water mark of the sea, a bay or an estuary
- a coastal lake
- a declared Ramsar wetland or World Heritage property,
- land declared as an aquatic reserve under the FM Act,
- land declared as a marine park under the *Marine Parks Act* 1997,
- land reserved or dedicated under the *National Parks and Wildlife Act* 1974
- land to which SEPP 14--Coastal Wetlands applies.

SEPP 71 areas relevant to the proposed project include:

- Wallaroo National Park transected by the pipeline from KP 59.7 to KP 63.
- SEPP 14 wetland transected by the pipeline for approximately 30 m at KP 68.9
- SEPP 14 wetlands adjacent to the pipeline at KP 86 and KP 88.

D.2.9 State Environmental Planning Policy 26 – Littoral Rainforest Protection (SEPP 26)

This policy applies to all communities of littoral rainforest in NSW, including the Hunter Valley. However, the proposed project would not occur near or interfere with any littoral rainforest communities.

Appendix E

TSC Act Section 5a Assessment (Seven-part Tests) for Threatened Ecological Communities and Species

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E.1 Introduction

Seven-part Test assessments are the prescribed standard method for assessing the potential impacts of proposed developments to species listed as threatened and ecological communities listed as endangered pursuant to the TSC Act Section 5A. Under most circumstances a species or community that fails to meet the standards set in the Seven-part Test will trigger a requirement for the preparation of a Species Impact Statement. However, developments that are assessed under Part 3a of the EP&A Act (i.e. State Significant Developments) do not require Seven-part Tests. Nevertheless, the Seven-part Test provides a rigorous and standardised format for assessment, so it used for that purpose in this report. In this case, however, the assessments cannot trigger a Species Impact Statement. The Seven-part Test is also used to assess potential impacts to species and ecosystems listed as threatened under the EPBC Act. The use of the Seven-part Tests in this way is recognised an accepted assessment approach to meet the requirements of the EP&A Act and through the bilateral agreement the EPBC Act (see the draft *Guidelines for Threatened Species Assessment under Part 3A of the Environmental Planning and Assessment Act 1979,* released by the Department of Planning, Department of Environment and Climate Change and Department of Primary Industries in November 2008).

The Seven-part Tests completed below for follow a standardised format. They open with a brief review of the ecology and habitat requirements of the subject species or community and the threats it faces. The majority of this information has been taken from the threatened species pages of the DECC website (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_species.aspx).

This is followed by responses to the seven test criteria (a) to (g):

> *(a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
>
> *(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*
>
> *(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: (i) is the proposal likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or (ii) is the proposal likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*
>
> *(d) In relation to the habitat of threatened species, population or ecological community:(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat; and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*
>
> *(e) Whether the action proposed is likely to have an adverse effect on critical habitat.*
>
> *(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*
>
> *(g) The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

Each test includes recommendations to mitigate any potential impacts to the species that were identified in the test. The mitigation recommendations given in the tests are expressed generally. The recommended mitigation measures are collated in **SECTION 5**, where more specific details are provided.

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Freshwater Wetlands on Coastal Floodplains of New South Wales North Coast, Sydney Basin and South East Corner Bioregions are listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

These wetlands occur in areas under 20 m elevation that are subject to periodic or semi-permanent inundation by freshwater (although there may be minor saline influence in some wetlands). Soils are generally silts, muds or humic loams. Typical landforms include depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Vegetation is dominated by herbaceous plants (e.g. sedges, reeds, herbs, grasses) with very few woody species. This community corresponds to LHCCREMS map unit 46 (freshwater wetland complex) and NSW map unit 56 (coastal freshwater lagoon).

The community is subject to a wide variety of threats, including land clearing, altered hydrology, reduced water quality and impacts from domestic and introduced species. Hydrology may be impacted by flood mitigation and drainage works and filling and excavation associated with urban and industrial development. Water quality may be affected by pollution and eutrophication from urban and agricultural runoff, dumping of landfill, rubbish and garden refuse soil, disturbance by pigs and activation of acid sulfate soils. Native vegetation maybe degraded by weed invasion and overgrazing and trampling by livestock. Native fauna may be threatened by predation, particularly by mosquito fish and cane toads.

This community is poorly reserved, with the closest reserve in Hexham Swamp. Some areas are protected by State Environmental Planning Policy 14. In the NSW North Coast bioregion, only 3% of the pre-European extent of this community was estimated to remain in the 1990s and an estimated 66% remained in the Lower Hunter Central Coast region. However, periodically inundated, treeless wetlands are difficult to map, so these figures may be relatively inaccurate. For example, several areas of this wetland type were mapped as non-remnant or forested wetland in existing mapping.

Freshwater Wetlands on Coastal Floodplains were recorded within or adjacent to the pipeline corridor at the following locations:

- an ephemeral wetland, which is dominated by sedges such as *Carex apressa* and *Juncus pallidus*, near the Williams River for about 0.9 km at approximately KP 67.8, including
  - transecting the wetland for about 0.15 km
  - transecting an artificial drainage channel, which is fringed by sedges for about 5 to 10 m
  - passing through cleared pasture just east of the wetland for 0.7 km
- passing through cleared pasture that lies in a 100 m gap between Williams River and a sedge-dominated wetland for 0.5 km at approximately KP 66.5 (detailed site assessment at flora site 20)
- passing through cleared pasture just north of the Williams River and just southeast of a narrow strip of wetland with sedges and occasional paperbarks (about 10 m wide at approximately KP 69.2)

- passing to the east of Woodberry Swamp (mapped as an SEPP14 wetland) for about 0.8 km at approximately KP 86
- passing to the east of Tarro Swamp (mapped as an SEPP14 wetland) for about 1.2 km at approximately KP 88.

(a) Not applicable

(b) Not applicable

(c) (i) The proposed development would directly impact on an ephemeral wetland of approximately 24 ha. It would transect 150 m of ephemeral sedge-dominated wetlands and 10 m of sedge-lined drainage channel. If the full 30 m ROW was cleared, this would require the removal of 0.5 ha of wetland (approximately 2.1% of the entire 24 ha wetland). However, actual clearing area would likely be much less by minimising clearing and disturbance width through this section. For example, reducing width to 10 m would reduce clearing to 0.16 ha (0.7%).

Based on LHCCREMS mapping (which only covers the southern third of the study area), 2970 ha of freshwater wetland complex remains within 5 km of the proposed alignment (the buffer area). The maximum clearing of 0.6 ha proposed by this development therefore represents only 0.02% of the estimated total extent in the buffer area. This would not be likely to significantly increase the risk of extinction for this community. With effective revegetation and weed management, it would be likely that this wetland can be restored to its previous condition, resulting in no net loss of wetlands within several years after construction.

(ii) Construction works may also indirectly impact on adjoining upstream wetlands (2 ha) and downstream wetlands (22 ha) through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds.

The proposed development also lies adjacent to several wetlands, so could have indirect impacts through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds.. With appropriate mitigation as proposed above (e.g. construction during dry periods, sediment and erosion control, minimising use and passage of heavy machinery and vehicles in wetland areas, trench wildlife management, reinstatement of previous soil profile and topography, revegetation and weed management), the proposed development would be unlikely to modify these wetlands to the extent that the risk of extinction is significantly increased.

(d) (i) The proposed development would directly impact on approximately 160 m of an ephemeral wetland. If the full 30 m ROW was cleared, this would require the removal of 0.5 ha of wetland (approximately 2.1% of the entire 24 ha wetland). Actual clearing is likely to be less than this maximum figure.

The proposed development lies adjacent to several wetlands, which may be modified through indirect impacts such as altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to have significant impacts on these wetlands.

(ii) The small extent of clearing required for this proposed development would be unlikely to contribute to increased fragmentation or isolation from other areas of wetland, with appropriate mitigation as recommended below.

(iii) The wetland directly impacted by the proposed development is approximately 24 ha. This represents only 0.8% of the total estimated area of this wetland within the 5 km buffer area. Nevertheless, the mitigation strategies proposed in this report aim to rehabilitate cleared wetlands with the gaol of no net loss of wetland habitat.

(e) No critical habitat has been declared by the Director-General of the NPWS for Freshwater Wetlands on Coastal Floodplains.

(f) The action proposed is not inconsistent with the 13 priority action statements identified to help the recovery of Freshwater Wetlands on Coastal Floodplains (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: the alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The mitigation strategies proposed in this report aim to minimise direct and indirect impacts on wetlands and rehabilitate impacted wetlands with the aim of no net loss or adverse alteration of wetland habitat.

Mitigation measures

Options to avoid or mitigate impacts on this wetland include:

- investigation of potential realignment of the pipeline to the east to pass upstream of wetlands (ongoing)
- investigation of potential HDD of the pipeline underneath the 150 m section of wetland (ongoing)
- investigation of the minimum clearing and disturbance width through wetland (ongoing)
- investigation for potential acid sulphate soils before construction and development and implementation of an appropriate management plan if detected
- construction and disturbance to be confined to dry periods (when wetland dry) as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to the wetland during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the wetland and enclosed in appropriate sediment and erosion control devices
- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology
- stockpiling and respreading of topsoil in wetland
- revegetation of wetlands with native wetland species as soon as possible following construction
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community is found on waterlogged or periodically inundated coastal floodplains, generally below 20 m elevation. It has a dense to sparse tree layer, which is dominated by Swamp Oak (*Casuarina glauca*). It often forms mosaics with other floodplain forest communities (e.g. Freshwater Wetlands on Coastal Floodplains) and treeless wetlands (e.g. Swamp Sclerophyll Forest of Coastal Floodplains). This community corresponds to LHCCREMS map unit 41 (Swamp Oak sedge forest) and 40 (Swamp Oak rusAECOMnd forest), CRA map unit 143 (Swamp Oak) and NSW map unit 50 (coastal floodplain wetland).

In the Lower Hunter - Central Coast region, less than 30 to 40% of the pre-European extent was estimated to remain in the 1990s. LHCCREMS mapping estimates that the 5 km buffer surrounding the lower third of the proposed pipeline contains 539 ha of Swamp Oak forest. This contrasts with CRA mapping, which estimates that only 169 ha remains within a 5 km buffer surrounding the entire pipeline.

The community is subject to a wide variety of threats, including land clearing, altered hydrology, reduced water quality and impacts from domestic and introduced species. Hydrology may be impacted by flood mitigation and drainage works and filling and excavation associated with urban and industrial development. Water quality may be affected by pollution and eutrophication from urban and agricultural runoff, dumping of landfill, rubbish and garden refuse, soil disturbance by pigs and activation of acid sulfate soils. Native vegetation maybe degraded by weed invasion and overgrazing and trampling by livestock. Some areas may be threatened by excessive fire frequency.

Swamp Oak Floodplain Forests were observed along the pipeline at the following locations:

- passing through a 50 m wide cleared strip through an open forest dominated by Swamp Oak for about 300 m at approximately KP 86 (to the east of Woodberry Swamp)
- passing through cleared pasture just south of the Williams River and just southeast of a narrow strip of wetland with an open canopy of swamp oaks and a dense ground story of sedges (about 50 m wide at approximately KP 70).

a) Not applicable

(b) Not applicable

(c) (i) The proposed development would not directly impact on any Swamp Oak Floodplain Forest, so will not directly alter the extent of this community.

(ii) The proposed development lies adjacent to several areas of Swamp Oak Floodplain Forest, so could have indirect impacts through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as described below, the proposed development would be unlikely to modify these wetlands to the extent that the risk of extinction is significantly increased.

(d) (i) The proposed development would not directly impact on any Swamp Oak Floodplain Forest. With appropriate mitigation as described below, potential indirect impacts that could modify this community would be considered unlikely.

(ii) The proposed development is unlikely to significantly increase fragmentation or isolation of this community.

(iii) No significant impacts on this community are considered likely, with appropriate mitigation as described below.

(e) No critical habitat has been declared by the Director-General of the NPWS for Swamp Oak Floodplain Forest.

(f) The action proposed is not inconsistent with the 11 priority action statements identified to help the recovery of Swamp Oak Floodplain Forest (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The mitigation strategies proposed in this report aim to minimise direct and indirect impacts on wetlands and rehabilitate impacted wetlands with the aim of no adverse alteration of wetland habitat.

Mitigation measures

Mitigation to minimise potential impacts include:

- investigation for potential acid sulphate soils before construction and development and implementation of an appropriate management plan if detected
- construction and disturbance to be confined to dry periods (when wetland dry) as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to the wetland during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the wetland and enclosed in appropriate sediment and erosion control devices
- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology
- stockpiling and respreading of topsoil
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.

Swamp Sclerophyll Forest of Coastal Floodplains of the New South Wales North Coast, Sydney Basin and the South East Corner

Swamp Sclerophyll Forest of Coastal Floodplains of the New South Wales North Coast, Sydney Basin and the South East Corner bioregions is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community is found on waterlogged or periodically inundated coastal floodplains, generally below 20 m elevation. It is typically an open forest dominated by *Melaleuca quinquinerva* (paperbark) and / or *Eucalyptus robusta* (swamp mahogany). Soils are generally humic clay loams or sandy loams. Swamp Sclerophyll Forest of Coastal Floodplains corresponds to LHCCREMS map units 37 (swamp mahogany paperbark swamp forest) and 42 (riparian Melaleuca swamp woodland / Melaleuca scrub), CRA map units 142 (swamp mahogany) and 112 (paperbark) and NSW map unit 50 (coastal floodplain wetland).

In the Lower Hunter - Central Coast region, about 30 of the pre-European extent was estimated to remain in the 1990s. LHCCREMS mapping estimates that the 5 km buffer surrounding the lower third of the proposed pipeline contains 328 ha of Swamp Sclerophyll Forest. This contrasts with CRA mapping, which estimates that only 172 ha remains within a 5 km buffer surrounding the entire pipeline.

The community is subject to a wide variety of threats, including land clearing, altered hydrology, reduced water quality and impacts from domestic and introduced species. Hydrology may be impacted by flood mitigation and drainage works and filling and excavation associated with urban and industrial development. Water quality may be affected by pollution and eutrophication from urban and agricultural runoff, dumping of landfill, rubbish and garden refuse, soil disturbance by pigs and activation of acid sulfate soils. Native vegetation may be degraded by weed invasion and overgrazing and trampling by livestock. Some areas may be threatened by excessive fire frequency and removal of dead wood.

Swamp Sclerophyll Forest of Coastal Floodplains was recorded adjacent to the pipeline for 0.2 km and is transected for about 30 m, just north of the Williams River at approximately KP 69. A detailed assessment of this community was conducted at flora site 21. The transected area has been partially cleared for a powerline corridor (Plate P5). A 10 m wide strip directly underneath the powerline is totally cleared, while the areas 10 to 20 m on either side contain well-established regenerating paperbark trees characteristic of this community. The majority of this community lies to the southeast of the proposed pipeline, with a small area also extending about 50 to 100 m to the northwest. This wetland (including the section transected by the proposed pipeline) is mapped as an SEPP 14 wetland.

a) Not applicable

(b) Not applicable

(c) (i) The proposed development would directly impact on a Swamp Sclerophyll Forest community with a total estimated area of 5.3 ha, located just north of the Williams River at approximately KP 69. The proposed pipeline will transect through a narrow 30 m section of the wetland. This section has been partially cleared for powerline construction and maintenance. If the proposed pipeline is placed outside the existing cleared corridor, the 30 m ROW will require 0.09 ha of clearing (1.7% of the entire community). However, it is likely that the ROW width would be reduced and placed partially within the cleared corridor, so clearing would be substantially less. Several other areas of Swamp Sclerophyll Forest are known in the vicinity of the Williams River, so removal of this small area would not be likely to significantly increase the risk of extinction for this community.

(ii) Construction works may also indirectly impact on this community through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to modify this wetland to the extent that the risk of extinction is significantly increased.

(d) (i) The proposed development would directly impact on a maximum of 0.09 ha. With appropriate mitigation as described below, potential indirect impacts that could modify this community would be considered unlikely.

(ii) The proposed development will temporarily isolate a small (about 0.3 ha) western section of the community from the larger (about 5 ha) eastern section of the wetland. However, with appropriate mitigation (including trench wildlife management), the proposed development would be unlikely to significantly increase fragmentation or isolation of this community.

(iii) Several other areas of Swamp Sclerophyll Forest are known in the vicinity of the Williams River. Estimates of remnant Swamp Sclerophyll Forest within the 5 km buffer surrounding the pipeline range were from 172 ha to 328 ha. The 5.3 ha community impacted by the present proposal therefore represents only 1.6 to 3% of the total area within the buffer and the proposed removal of 0.09 ha is only 0.03 to 0.05% of the total area. Nevertheless, the mitigation strategies proposed in this report aim to minimise clearance and other impacts on Swamp Sclerophyll Forest.

(e) No critical habitat has been declared by the Director-General of the NPWS for Swamp Sclerophyll Forest.

(f) The action proposed is not inconsistent with the 12 priority action statements identified to help the recovery of Swamp Sclerophyll Forest (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The mitigation strategies proposed in this report aim to minimise direct and indirect impacts on wetlands and rehabilitate impacted wetlands with the aim of no adverse alteration of wetland habitat.

Mitigation Measures

Options to avoid or mitigate impacts on this wetland include:

- investigation of potential realignment of the pipeline to the west to avoid this wetland (ongoing)
- investigation of potential HDD of the pipeline underneath the 30 m section of wetland (ongoing)
- investigation of the minimum clearing and disturbance width through wetland, including use of the existing 10 m cleared strip underneath the powerline (ongoing)
- investigation for potential acid sulphate soils before construction and development and implementation of an appropriate management plan if detected
- construction and disturbance to be confined to dry periods as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to the wetland during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the wetland and enclosed in appropriate sediment and erosion control devices

- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology
- stockpiling and respreading of topsoil in wetland
- revegetation of wetlands with native wetland species as soon as possible following construction
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.

Hunter Lowland Redgum Forest

Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community occurs on gentle slopes arising from depressions and drainage flats on Permian sediments. It is generally an open forest with a canopy dominated by *Eucalyptus tereticornis* and *Eucalyptus punctata*. The sparse mid stratum may include *Breynia oblongifolia, Leucopogon juniperinus, Daviesia ulicifolia* and *Jacksonia scoparia* and the ground layer contains various grasses and herbs. This community corresponds to LHCCREMS map unit 19 (Hunter lowlands redgum forest), CRA map unit 47 (Redgum / apple) and NSW map unit 21 (Northern hinterland semi-mesic forest).

LHCCREMS mapping estimates that the 5 km buffer surrounding the lower third of the proposed pipeline contains 161 ha of Hunter Lowland Redgum Forest. CRA mapping estimates that 1243 ha remains within a 5 km buffer surrounding the entire pipeline. Only about 27% (less than 500 ha) of the pre-European extent of Hunter Lowland Redgum Forest was estimated to remain in the 1990s and this is highly fragmented. Less than 2% of this community is reserved in the Wereketa (previously Lower Hunter) National Park, with most of the remainder in private tenure. Threats include clearing and associated fragmentation, grazing, weed invasion, altered fire frequency and, locally, rubbish dumping.

A small area of Hunter Lowland Redgum Forest was recorded along Little Black Camp Creek at approximately KP 45.5 (**Plate 6**). The pipeline transected a 100 m wide strip of open forest dominated by forest red gum on alluvial soils. The community was dissected by a 20 m wide clearing associated with Black Camp Creek Road. To the west of the road, the community had been partially cleared with a canopy cover of about 10%, while the eastern side was much denser with a canopy cover up to 40%. The vegetation on the western edge of the road is considered to be regrowth, while the eastern side is remnant.

a) Not applicable

(b) Not applicable

(c) (i) The proposed development would transect a 100 m band of Hunter Lowland Redgum Forest. Clearing of the full 30 m ROW would require removal of to 0.3 ha of this community. However, this figure could be reduced by reducing the ROW along this short section. Impacts could be further reduced by aligning the ROW to follow the western side of the road, where the community was partially cleared. By following these recommendations, the proposed development would be likely to avoid clearing of any remnant vegetation and therefore would not be likely to significantly increase the risk of extinction for this community.

(ii) Construction works may also indirectly impact on this community through altered stream hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of riparian weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to modify this community to the extent that the risk of extinction is significantly increased.

(d) (i) By transecting regrowth vegetation on the western edge of Black Camp Creek Road and reducing ROW width through this 100 m section, the proposed development would be likely to avoid clearing of any remnant vegetation. With appropriate mitigation as described below, potential indirect impacts that could modify this community would be considered unlikely.

(ii) This community and other vegetation associated with Little Black Camp Creek and Black Camp Creek form a relatively continuous corridor between larger remnant vegetation blocks to the east and west. Black Camp Creek Road dissects this corridor in a cleared strip about 10 to 20 m wide. The proposed development will temporarily impact on connectivity along this corridor. However, with appropriate mitigation (including minimising construction time through this section, trench wildlife management and revegetation of the riparian corridor), the proposed development would be unlikely to significantly increase fragmentation or isolation of this community in the medium to long term.

(iii) The proposed development would be likely to avoid clearing of any remnant vegetation. With appropriate mitigation as described below, potential indirect impacts that could modify this community would also be considered unlikely. Revegetation and maintenance of the ROW following construction would aim to increase the area of remnant Hunter Lowland Redgum Forest in the medium to long term.

(e) No critical habitat has been declared by the Director-General of the NPWS for Hunter Lowland Redgum Forest.

(f) The action proposed is not inconsistent with the 19 priority action statements identified to help the recovery of Hunter Lowland Redgum Forest (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: clearing of native vegetation. The mitigation strategies proposed in this report aim to avoid clearing of any remnant Hunter Lowland Redgum Forest and to revegetation the ROW with native species characteristic of this community.

Mitigation measures

Options to avoid or mitigate impacts on this community include:

- investigation of potential realignment of the pipeline to regrowth vegetation along the western edge of Black Camp Creek Road (ongoing)
- investigation of the minimum clearing and disturbance width through this section (ongoing)
- construction and disturbance to be confined to dry periods as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to riparian areas during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the riparian area and enclosed in appropriate sediment and erosion control devices
- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology

- stockpiling and respreading of topsoil in riparian areas
- revegetation of the riparian area with native species characteristic of this community as soon as possible following construction
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.

Lowland Rainforest on Floodplains of the NSW North Coast Bioregion

Lowland Rainforest on Floodplains of the NSW North Coast Bioregion is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community occurs on fertile soils in lowland river valleys in the NSW North Coast Bioregion. In an undisturbed state, it is characterised by a closed canopy with high species diversity and structural complexity. In disturbed stands, it may have a broken canopy or a canopy smothered by exotic vines. This community corresponds to some components of LHCCREMS map unit 3 (Hunter Valley dry rainforest) and NSW map unit 4 (dry rainforest).

This community has been reduced to less than 1,000 ha, primarily by clearing for agriculture. Existing and potential threats include clearing, invasion of edges and disturbed remnants by exotic plant species, disruption of plant regeneration (e.g. pollination, seed dispersal) from fragmentation, fire, grazing, rubbish dumping and dissection by tracks. Only a small proportion of the total area of this community is contained within conservation reserves.

Lowland Rainforest on Floodplains of the NSW North Coast Bioregion was recorded at three crossings of the Karuah River along the proposed pipeline corridor:

- 70 m riparian area from KP 19.23 to KP 19.29
- 60 m riparian area from KP 23.51 to KP 23.57
- 110 m riparian area from KP 24.29 to KP 24.4.

Other riparian vegetation recorded within the GFDA and the pipeline corridor was not considered to meet the diagnostic criteria for this EEC.

(a) Not applicable

(b) Not applicable

(c) (i) The proposed alignment transects three narrow bands of Lowland Rainforest on Floodplains, totalling approximately 240 m. Conventional construction methods would require clearing of up to 0.72 ha of this community. However, HDD techniques are proposed for all crossings of the Karuah River, which would avoid any clearing of this EEC. Therefore, the action is not expected to have any adverse effect on the extent of this EEC such that its local occurrence is likely to be placed at risk of extinction.

(ii) Construction works may also indirectly impact on this EEC through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of riparian weeds. With appropriate mitigation as proposed below (e.g. construction during dry periods, sediment and erosion control, minimising use and passage of heavy machinery and vehicles adjacent to riparian areas, trench wildlife management, reinstatement of previous soil profile and topography, revegetation and weed management), the proposed development would be unlikely to have any adverse effect on the composition of this EEC such that its risk of extinction is significantly increased.

(d) (i) While conventional construction methods would require clearing of up to 0.72 ha, proposed HDD techniques would avoid any clearing of this EEC. Indirect impacts could include altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to have significant impacts on this community.

(ii) The proposed development would be unlikely to contribute to increased fragmentation or isolation from other areas of this community, with appropriate mitigation as recommended below.

(iii) No habitat would be removed, modified, fragmented or isolated by the proposed development with appropriate mitigation as proposed below.

(e) No critical habitat has been declared by the Director-General of the NPWS for Lowland Rainforest on Floodplains of the NSW North Coast Bioregion.

(f) The action proposed is not inconsistent with the 21 priority action statements identified to help the recovery of Lowland Rainforest on Floodplains of the NSW North Coast Bioregion (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, four are relevant to the proposed development:

- invasion and establishment of exotic vines and scramblers
- invasion, establishment and spread of *Lantana camara*
- alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
- clearing of native vegetation.

The mitigation strategies proposed in this report aim to avoid clearing and minimise indirect impacts on lowland rainforest with the aim of no net loss or adverse alteration of this habitat.

Mitigation measures

Options to avoid or mitigate impacts on lowland rainforest include:

- Use HDD techniques to place the pipeline underneath the three recorded sections of lowland rainforest on the Karuah River.
- Construction and disturbance to be confined to dry periods (when areas surrounding the Karuah River are dry) as far as practical.
- Minimisie the construction time (especially period of open tunnels and trenches).
- Minimise the use and passage of heavy machinery and vehicles adjacent to the riparian areas during construction.
- Developt and implement appropriate sediment and erosion control systems during construction.
- Install appropriate wildlife bridges, ladders and shelters in open trenches.
- Have qualified fauna handlers on site to remove any trapped wildlife from the open trench each day.
- Store soil stockpiles well away from the riparian area and enclosed in appropriate sediment and erosion control devices.
- Reinstate the previous soil profile and topography as far as practical to minimise impacts on natural hydrology.
- Stockpilie and respreadi topsoil in construction areas adjacent to Karuah River.

- Revegetate disturbed areas adjacent to Karuah River with appropriate species as soon as possible following construction.
- Develop and implement weed and phytophthora management protocols (including hygiene and control) during and for at least two years following construction.

***Acacia pendula* (Weeping Myall): Endangered Population**

Acacia pendula is listed as an Endangered Population under the NSW TSC Act.

Acacia pendula is an erect or spreading tree 5-13 m high, which flowers mainly in summer and autumn. Seed pods can be from 3 to 9 cm long and 10 to 20 mm wide.

Acacia pendula occurs on the western slopes, western plains and far western plains of NSW, and south into Victoria and north into Queensland. A disjunct population of *Acacia pendula* occurs in the Hunter Valley at the eastern distributional limit of the species' range. This Hunter population is known to occur naturally as far east as Warkworth, and extends northwest to Muswellbrook and to the west of Muswellbrook at Wybong. It has been recorded in the local Government Areas of Mid-Western Regional, Muswellbrook, Singleton and Upper Hunter. Within the Hunter catchment *Acacia pendula* typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations.

The Hunter population of *Acacia pendula* is fewer than 1000 individuals, from 6 locations - Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. It is not known to occur within any conservation areas - recent surveys on reserves where it could potentially occur have not detected it e.g. Belford National Park, Werakata National Park.

The threats to the population include:

- land clearing
- grazing of young plants
- demographic and enviromental stochasticity due to its small population size
- inappropriate roadside management.
- Acacia pendula was not recorded during field surveys.

(a) Not applicable.

(b) Acacia pendula has only been recorded in six locations in NSW. None of these locations are within the proposed development area and it is highly unlikely that this species occurs in the proposed development area. Therefore, it is unlikely that the lifecycle of this species will be adversely affected by the proposed development

(c) Not applicable.

(d) None of the current known locations of *Acacia pendula* populations occur within the proposed development area, therefore, (i) it is unlikely that potential habitat for this species will be modified; (ii) it is unlikely that any fragmentation or isolation of potential habitat will result and (iii) it is unlikely that the proposed development will modify or remove vital habitat for the populations' long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Acacia pendula*.

(f) Acacia pendula is highly unlikely to occur in the project area.

(g) Key threatening processes are not relevant because none of the current known locations of *Acacia pendula* populations occur within the proposed development area.

Mitigation measures

Acacia pendula is highly unlikely to occur in the project area. No specific mitigation measures are required.

***Cymbidium canaliculatum* (Tiger Orchid): Endangered Population**

Cymbidium canaliculatum in the Hunter catchment is listed as an Endangered population under the TSC Act. *Cymbidium canaliculatum* is a large epiphytic orchid that grows in the hollows of trees in dry sclerophyll forest or woodland.

Cymbidium canaliculatum has a scattered distribution in northern and eastern Australia from northeast NSW, through Queensland and the Northern Territory to Western Australia. In NSW it occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. Within the Hunter Catchment, *Cymbidium canaliculatum* is most commonly found in *Eucalyptus albens* (white box) dominated woodlands, usually occurring singly or as a single clump, typically between two and six metres above the ground. It has been found, less commonly, to grow on *E. dawsonii* (Slaty Box), *E. crebra* (Narrow-leaved Ironbark), *E. moluccana* (Grey Box), *Angophora floribunda* (Rough-barked Apple), *Acacia salicina* (Cooba) and on some other species.

In the Hunter Catchment, *C. canaliculatum* is known to occur within Wollemi and Goulburn River National Parks but it is estimated that about 90% of the population occurs on land not managed for conservation.

Threats to the population include:

- land clearing and habitat fragmentation
- removal of remnant trees
- illegal collecting.

Cymbidium canaliculatum was not recorded during the field surveys. Potential habitats were recorded in dry sclerophyll forests and woodlands.

(a) Not applicable.

(b) Potential habitat for *Cymbidium canaliculatum* may occur in the project area; however, this species has only been recorded in Wollemi and Goulburn River National Parks which are not located in the proposed development area.Therefore, it is unlikely that this species occurs within the proposed development area and it is unlikely that the proposed development will adversely impact on the life cycle of the population.

(c) Not applicable.

(d) Given the known current locations of *Cymbidium canaliculatum* populations, it is unlikely that this species occurs within the proposed development area. However, potential habitat may exist for this species within the proposed development area. Therefore, (i) the proposed development would result in the removal of 15.6 to 18.8 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented; and (iii) only minimal modification of potential habitat is expected, so there is unlikely to be any long-term impact on the species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Cymbidium canaliculatum*

(f) There is currently no recovery plan or threat abatement plan for the *Cymbidium canaliculatum.* No priority action statements have been prepared to help recover this population (DEC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the *Cymbidium canaliculatum*: clearance of native vegetation. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing.

Mitigation measures

To minimise potential impacts to *Cymbidium canaliculatum* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Cymbidium canaliculatum* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Avoid causing any significant changes to current fire regimes.

***Eucalyptus parramattensis* subsp*. parramattensis* (Parramatta Red Gum): Endangered Population**

Eucalyptus parramattensis population in Wyong and Lake Macquarie local government areas is listed as an Endangered population under the TSC Act.

This species is a small to medium-sized woodland tree with bark which sheds in large plates to leave a smooth or matt mottled grey and white surface. Adult leaves are dull green, lance-shaped and 7 - 20 cm long by 1 - 3.5 cm wide. White flowers are clustered in groups of seven and the fruit is ball-shaped. The endangered population numbers approximately 1,300 trees.

The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong local government areas is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and Wallarah Creek catchments. This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E. tereticornis* (Forest Red Gum), *E. gummifera* (Sydney Bloodwood) and *Melaleuca* (Paperbark) species.

Threats include:

- habitat loss and fragmentation due to localised clearing and residential development
- habitat degradation resulting from altered hydrology / nutrient levels and grazing.

Eucalyptus parramattensis was not recorded during the field surveys. Potential habitats were recorded along drainage lines and adjacent to wetlands.

(a) Not applicable.

(b) Potential habitat for *Eucalyptus parramattensis* may occur in the project area. Provided that the proposed development avoids impact or damage to any preferred habitat and a pre-clearance survey is conducted for individuals prior to any vegetation clearing, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(c) Not applicable.

(d) Provided that mitigation measures listed below are followed then: (i) only approximately 0.76 ha of potential habitat is likely to be removed; (ii) No fragmentation or isolation of habitat should result and (iii) it is unlikely that habitat vital to the long-term survival of the species will be modified or removed.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Eucalyptus parramattensis*

(f) There is currently no recovery plan or threat abatement plan for the *Eucalyptus parramattensis.* No priority action statements have been prepared to help recover this species (DEC, 2005).

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the *Eucalyptus parramattensis*: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing and any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to *Eucalyptus parramattensis* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus parramattensis* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Eucalyptus parramattensis.*

***Eucalyptus seeana* (Narrow-leaved Red Gum): Endangered Population**

Eucalyptus seeana in the Greater Taree local government area is listed as an Endangered population under the TSC Act. *Eucalyptus seeana* is a medium to tall woodland tree to 40 m. Bark is smooth and mottled. Leaves are long, narrow and lance-shaped, up to 18 cm long and 2 cm wide. Buds are elongated, horn-shaped, 8-15 mm long. Fruit is hemispherical, 5 - 8 mm wide.

The species has a distribution from the north coast of NSW to south east Queensland. The Endangered Population within the the Greater Taree Local Government Area represents the southern-most occurrence of the species and is isolated from other populations of the species to the north. Within the Greater Taree Local Government Area the population is sporadic in distribution, consisting mainly of scattered trees but with some denser stands. A small part of the population occurs in a Council reserve. It occurs as scattered individuals in woodlands and open forests on low, often swampy, sandy soils.

Threats to this population include:

- clearing and fragmentation of habitat across the LGA due to clearing for agriculture, urban expansion and infrastructure development
- weed invasion
- forestry activities.

Eucalyptus seeana was not recorded during the field surveys. Potential habitats were recorded in woodlands and open forests.

(a) Not applicable.

(b) Potential habitat for *Eucalyptus seeana* may occur in woodlands and open forests within the proposed project area. Provided that the proposed development avoids impact or damage to any preferred habitat and a pre-clearance survey is conducted for individuals prior to any vegetation clearing, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(c) Not applicable.

(d) Provided that mitigation measures listed below are followed then: (i) only 15.6 to 18.9 ha of woodland and open forest habitat is likely to be removed or modified; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) only a small amount of potential habitat is likely to be modified, so there is unlikely to be any long-term impact on the species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Eucalyptus seeana.*

(f) There is currently no recovery plan or threat abatement plan for the *Eucalyptus seeana*. No priority action statements have been prepared to help recover this species (DEC, 2005

(g) Of the 31 key threatening processes listed in NSW, five are relevant to the proposed development and *Eucalyptus seeana*: clearance of native vegetation and four processes relating to the spread of invasive weeds.The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise clearing and implement practices to reduce to spread of weeds.

Mitigation measures

To minimise potential impacts to the *Eucalyptus seeana* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus seeana* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.

***Rhizanthella slateri* (Eastern Australian Underground Orchid): Endangered Population**

Rhizanthella slateri is an endemic Australian orchid that has been described as a terrestrial saprophytic herb (i.e. grows on and derives its nourishment from dead or decaying organic matter) with a fleshy underground stem to 15 cm long and 15 mm in diameter. The flower heads mature below the soil surface but sometimes may extend 2 cm above the ground, and are about 2 cm in diameter. The receptacle has up to 18 bracts about 8 mm long and has up to 30 flowers which are tubular and purplish. The bracts are prominent, often branching, fleshy, whitish and overlapping.

Biologically, *Rhizanthella slateri* is of significant conservation value because of its unusual life cycle. It is one of only three Australian species, and a small number of species worldwide, that are capable of completing their entire lifecycle underground. Subterranean flowering plants such as these are extremely unusual and are of great scientific interest to biologists all over the world.

Rhizanthella slateri is restricted to New South Wales where it is currently known from fewer than 10 locations including Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The *Rhizanthella slateri* population in the Great Lakes local government area (LGA) occurs at the known northern limit of the species' range and is disjunct from other known populations of the species.

Surveys conducted between 2002 and 2005 identified approximately 75 flowerheads at a site within the Great Lakes LGA, more than ten times the number observed at any other site. The *Rhizanthella slateri* population in the Great Lakes LGA is thus likely to be the largest and most extensive known population of the species. Other known populations of *Rhizanthella slateri* are fragmented and highly disjunct, comprising isolated individuals or small clusters of plants.

Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.

The ecology of *Rhizanthella slateri* is highly obscure given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore plants are usually located only when the soil is disturbed. *Rhizanthella slateri* flowers in October and November.

Rhizanthella slateri was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in sclerophyll forests in the project area.

Threats to the *Rhizanthella slateri* population in the Great Lakes LGA include:

- a proposal to construct a road through the population which will result in the direct removal of 4% of the known population, threaten 34% of the known population indirectly by altering drainage and soil moisture, and increase weed invasion
- illegal collecting
- environmental and demographic stochasticity due to its restricted area and small size.

Rhizanthella slateri was not recorded during the field surveys. Very liitle is known about the species habitat preferences although potential habitat in sclerophyll forests was recorded in the proposed development area.

(a) Not applicable.

(b) Potential habitat for *Rhizanthella slateri* may occur in the project area but due to the lack of information regarding the distribution of this species it is difficult to determine whether the proposed development will adversely impact on the species' life cycle. It has been recorded from sclerophyll forest, so the proposed development may result in the removal of 16 to 25 ha of potential *Rhizanthella slateri* habitat.

(c) Not applicable.

(d) Provided that the mitigation measures listed below are followed then: (i) only 16.7 to 25 ha of remnant vegetation will be removed, although this species may occur outside of remnant vegetation and therefore more potential habitat may be removed; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) given the lack of knowledge regarding the distribution of this species it is difficult to determine the importance of any habitat that may be removed.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Rhizanthella slateri.*

(f) There is currently no recovery plan or threat abatement plan for the *Rhizanthella slateri*. No priority action statements have been prepared to help recover this population (DEC, 2005).

(g) Of the 31 key threatening processes listed in NSW, three may be relevant to the proposed development and *Rhizanthella slateri*: clearance of native vegetation and removal of dead wood and dead trees and infection of native plants by *Phytophthora cinnamomi*. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise clearing, replace dead organic matter wherever possible and avoid spread of *Phytophthora cinnamomi*.

Mitigation measures

To minimise potential impacts to the *Rhizanthella slateri* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should attempt to ensure that no *Rhizanthella slateri* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.

- Ensure topsoil is stockpiled and respread as soon as possible after construction.
- Develop and implement weed and phytophthora management protocols (including hygiene and control) during and for at least two years following construction.

***Asperula asthenes* (Trailing Woodruff): Vulnerable**

Asperula asthenes is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. Trailing Woodruff is a low, trailing perennial herb with leaves in whorls of four around the stem. It has tiny fragrant white star-shaped flowers followed by tiny two-lobed fruit, only 1 mm long.

The small herb occurs only in NSW in damp sites, often along river banks. It is found in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens/Wallis Lakes area.

Asperula asthenes was not recorded during the field surveys. The desktop survey revealed one previous record from within a 5 km buffer of the project area. Potential habitats were recorded along streams within the northern parts of the project area.

Threats include:

- disturbance from grazing stock
- invasion of habitat by introduced weeds, particularly near watercourses
- use of herbicides.

(a) The proposed development would result in the removal of potential *Asperula asthenes* habitat (up to 1 ha of wetland and rainforest stream habitats). This impact is expected to be minimal as HDD techniques are recommended wherever pipeline construction crosses wetlands and permanent streams and all construction should avoid riparian vegetation and hydrological and disturbance. Furthermore, provided pre-construction survey for *Asperula asthenes* is conducted, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) A limited extent of potential habitat for *Asperula asthenes* (up to 1 ha depending on construction methods) could be encountered within the project area, and provided mitigation measures are adopted: (i) habitat would only be removed in short narrow strips and so potential habitat is unlikely to be modified; (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Asperula asthenes.*

(f) There is currently no recovery plan or threat abatement plan for *Asperula asthenes*. Nine priority action statements have been prepared to help recover this species (DEC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, five are relevant to the proposed development and *Asperula asthenes*: clearance of native vegetation and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to *Asperula asthenes* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Asperula asthenes* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Consider HDD techniques wherever pipeline construction crosses wetlands and permanent streams to avoid riparian vegetation and hydrological disturbance.
- Develop and implement a detailed weed management strategy that considers this species' sensitivity to herbicides.

***Callistemon linearifolius* (Netted Bottle Brush): Vulnerable**

Callistemon linearifolius is listed as Vulnerable under the TSC Act. A shrub up to 3-4 m tall, with linear (long and narrow) to linear-lanceolate (lance shaped) leaves 8-10 cm long, and 5-7 mm wide with a sharp tip, thickened margins, and distinct lateral veins. Flowers are clustered into the typical "bottlebrushes" of Callistemons and takes place spring to summer. The brushes are red and usually 9-10 cm long and approximately 50 mm in diameter. The stem upon which the filaments occur are covered in a soft downy hair at flowering. The seed capsules are approximately 7 mm in diameter.

Callistemon linearifolius grows in dry sclerophyll forest on the coast and adjacent ranges and is recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Where this species was more widespread across its distribution in the past, there are currently only 5-6 populations in the Sydney area of the 22 populations recorded in the past. Three of these are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park.

Callistemon linearifolius was not recorded during the field surveys. The desktop survey revealed three previous records from within a 5 km buffer of the project area. Potential habitats were recorded in dry sclerophyll forest in the project area.

Threats include:

- continuing loss of habitat due primarily to urban development
- a high risk of local extinction due to low population numbers.

(a) The proposed development would result in the removal of potential *Callistemon linearifolius* habitat (15 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Callistemon linearifolius.*

(f) There is currently no recovery plan or threat abatement plan for *Callistemon linearifolius*. There are 13 priority action statements that have been prepared to help recover this species (DEC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Callistemon linearifolius*: clearance of native vegetation. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to *Callistemon linearifolius* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Callistemon linearifolius* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.

***Cryptostylis hunteriana* (Leafless Tongue Orchid): Vulnerable**

Cryptostylis hunteriana is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. The Leafless Tongue Orchid has no leaf and it produces an upright flower-stem to 45 cm tall, bearing five to 10 flowers between November and February. It has small narrow green sepals and petals to 22 mm long, but is dominated by an erect narrow very hairy 'tongue' (the labellum). This is up to 33 mm long, maroon along the margins and at the widened tip, and with a black central band. All other tongue orchids have leaves; most have a downward pointing labellum.

The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park, Ben Boyd National Park.

Cryptostylis hunteriana does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*). Little is known about the ecology of the species; being leafless it is expected to have limited photosynthetic capability and probably depends upon a fungal associate to meet its nutritional requirements from either living or dead organic material. In addition to reproducing from seed, it is also capable of vegetative reproduction and thus forms colonies which can become more or less permanent at a site.

Cryptostylis hunteriana was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in woodlands in the project area.

Threats include:

- development pressure on coastal sites where it occurs
- road works.

(a) The proposed development would result in the removal of potential *Cryptostylis hunteriana* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Cryptostylis hunteriana.*

(f) There is currently no recovery plan or threat abatement plan for *Cryptostylis hunteriana*. There are four priority action statements that have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Cryptostylis hunteriana*: clearance of native vegetation. The proposed development has the potential to contribute to this key threatening processe on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to *Cryptostylis hunteriana* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Cryptostylis hunteriana* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.

***Cynanchum elegans* (White-flowered Wax Plant): Endangered**

Cynanchum elegans is listed as Endangered under the TSC Act and Endangered under the EPBC Act. A climber or twiner with a highly variable form, mature stems have a fissured corky bark and can grow to 10 metres long and 3.5 cm thick. The leaves are paired (or rarely in threes), ovate to broadly ovate in shape, 1.5 to 10.5 cm long, and 1.5 to 7.5 cm wide. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific. The flowers are white, tubular, and up to 4 mm long and 12 mm wide. The fruit is a dry pointed pod to 8 cm long, which contains up to 45 seeds with long silky hairs attached to one end. The fruit can take up to six months to mature. Seed production is variable and unreliable, seeds are wind dispersed and it is considered to be unlikely that a soil seed bank for this species exists. Plants are capable of suckering from rootstock in response to occasional slashing or grazing. The fire response of the species is unknown.

The White-flowered Wax Plant is restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley.

The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree *Leptospermum laevigatum* – Coastal Banksia *Banksia integrifolia* subsp. *integrifolia* coastal scrub; Forest Red Gum *Eucalyptus tereticornis* aligned open forest and woodland; Spotted Gum *Corymbia maculata* aligned open forest and woodland; and Bracelet Honeymyrtle *Melaleuca armillaris* scrub to open scrub.

Cynanchum elegans was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in the project area in Forest Red Gum, dry rainforest and Spotted Gum forests and woodlands.

Threats include:

- further loss and fragmentation of habitat, particularly through clearing for agriculture, quarries and residential development
- habitat degradation resulting from weed invasion, grazing, rubbish dumping, landfill, urban run-off, track construction / widening, and inappropriate fire management
- small numbers, which put the species at risk of extinction through natural catastrophes or environmental changes.

(a) The proposed development would result in the removal of potential *Cynanchum elegans* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Cynanchum elegans.*

(f) There is currently no recovery plan or threat abatement plan for *Cynanchum elegans*. There are nine priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Cynanchum elegans*: clearance of native vegetation, consequences of high frequency fire and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats. Furthermore, the proposed development would not increase the frequency of fires in the study area.

Mitigation measures

To minimise potential impacts to *Cynanchum elegans* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Cynanchum elegans* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Avoid causing any significant changes to current fire regimes.
- Develop and implement a detailed weed management strategy.

***Eucalyptus glaucina* (Slaty Red Gum): Vulnerable**

Eucalyptus glaucina is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. *Eucalyptus glaucina* is a medium-sized tree to 30 m tall. The bark is smooth and mottled white to slaty grey. The juvenile leaves are oval in shape and blue-green with a whitish bloom, and the buds and fruit are similarly coloured. The flowers are white, or occasionally pink, and are produced between August and December. The fruits are oval-shaped and 7– 10 mm long. The three to five raised valves are surrounded by a domed disk raised above the fruit.

Eucalyptus glaucina is found only on the north coast of NSW and in separate districts: near Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland. It grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.

Eucalyptus glaucina was not recorded during the field surveys. The desktop survey revealed two previous records from within a 5 km buffer of the project area. Potential habitats were recorded in grassy woodlands or dry eucalypt forest in the project area.

Threats include:

- clearing for agriculture and development
- timber harvesting activities
- lack of regeneration through grazing pressure.
- *(a)* The proposed development would result in the removal of potential *Eucalyptus glaucina* habitat (15 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.
- *(b)* Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures listed below are implemented, then: (i) the proposed development would result in the removal of 15 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Eucalyptus glaucina.*

(f) There is currently no recovery plan or threat abatement plan for *Eucalyptus glaucina*. Eleven priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Eucalyptus glaucina*: clearance of native vegetation. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to *Eucalyptus glaucina* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus glaucina* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.

***Eucalyptus parramattensis* subsp*. decadens*: Vulnerable**

Eucalyptus parramattensis subsp*. decadens* is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. *Eucalyptus parramattensis* subsp*. decadens* is a woodland tree, up to 15 m, but usually to about 8 – 10m in height. Its bark sheds in large plates to leave a smooth, granular and mottled white or grey surface. Juvenile and adult leaves are disjunct. Juvenile leaves are narrow-lanceolate to lanceolate, dull green both sides. Adult leaves are usually lance-shaped to about 15 cm long and 2 cm wide. Inflorescences are 7–flowered. Buds are ovoid 4 – 10mm long, 4 – 6 mm in diameter with a scar present. Fruit is hemispherical or globose 4 – 9 mm long, 5 – 9 mm in diameter, with the disc flat or slightly raised, usually with four exserted valves. This species is likely to be sensitive to over-frequent fire, however there is evidence (i.e. coppicing, epicormic shoots) that the species may be tolerant of low intensity fires. The species has a canopy-stored seed bank for dispersal after fire events.

There are two separate meta-populations of *E. parramattensis subsp. decadens*. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the sub-species are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south.

E. parramattensis subsp. decadens generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heatAECOMnd. Often where this species occurs, it is a community dominant.

Eucalyptus parramattensis subsp*. decadens* was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Although deep sands were not recorded in the project area, dry sclerophyll woodlands could provide potential habitats.

Threats include:

- habitat loss and fragmentation resulting from development, particularly sand mining, road construction and residential/industrial developments
- weed invasion, in particular Lantana and Bitou Bush
- modifications of drainage regimes in deep, low nutrient sands through draining or filling
- over-frequent fire, which may prevent recruitment of new individuals to the population, leading over the longer term to decline and local extinction.
- *(a)*While the proposed development would result in the removal of potential *Eucalyptus parramattensis* subsp*. decadens* habitat (15 to 25 ha of timbered habitats depending on construction methods), the propsed development is both north and west of the known metapopulations of this species and no deep sandy soils were recorded. Therefore it is unlikely the the proposed development will have an affect on the life cycle of this species. Any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.
- *(b)* Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures listed below are implemented, then: (i) the proposed development would result in the removal of 15 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Eucalyptus parramattensis* subsp*. decadens.*

(f) There is currently no recovery plan or threat abatement plan for *Eucalyptus parramattensis* subsp*. decadens*. Nine priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, seven are relevant to the proposed development and *Eucalyptus parramattensis* subsp*. decadens*: clearance of native vegetation, consequences of high frequency fire, alteration to natural flow regimes and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, spread weeds, increase the risk of fire or alter the natural flow regimes of creeks and rivers.

Mitigation measures

To minimise potential impacts to *Eucalyptus parramattensis* subsp*. decadens* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus parramattensis* subsp*. decadens* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Avoid causing any significant changes to current fire regime.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.

***Grevillea guthrieana* (Guthrie's Grevillea): Endangered**

Grevillea guthrieana is listed as Endangered under the TSC Act and Endangered under the EPBC Act. It is a spreading shrub to 2 m high or occasionally to 4 m high. The branchlets are covered with long hairs when young and the leaf undersurface is also hairy. The narrow leaves are 2 to 6 cm long and less than 1 cm wide. The flowers are green and maroon and form at the end of the branchlets.

Grevillea guthrieana is known from the north coast of NSW, at Booral near Bulahdelah and on the Carrai Plateau, south-west of Kempsey. It grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil.

Grevillea guthrieana was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded along creeks or in eucalypt forests in the project area.

Threats include:

- clearing of habitat
- inappropriate fire regimes (too-frequent fires can inhibit regeneration)
- damage from grazing stock
- susceptibility to dieback caused by root rot fungus (*Phytophthora cinnamomi*).
- *(a)* The proposed development would result in the removal of potential *Grevillea guthrieana* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.
- *(b)* Not applicable.

(c) Not applicable.

(d) Provided that mitigation measures below are implemented, then: (i) the proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Grevillea guthrieana.*

(f) There is currently no recovery plan or threat abatement plan for *Grevillea guthrieana*. Seven priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and *Grevillea guthrieana*: clearance of native vegetation, consequences of high frequency fire and infections by *Phytophthora cinnamomi.* The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, spread weeds, alter the fire regime or spread plant diseases.

Mitigation measures

To minimise potential impacts to *Grevillea guthrieana* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Grevillea guthrieana* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Avoid causing any significant changes to current fire regime.
- Avoid the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.

- Develop and implement an equipment hygiene strategy to ensure that plant pathogens are not transported in soil on vehicles and equipment.

***Grevillea parviflora* subsp. *parviflora* (small-flower grevillea)**

Grevillea parviflora subsp. *parviflora* is listed as Vulnerable in Schedule 2 of the TSC Act and Vulnerable under the EPBC Act. This low spreading to erect shrub, reaching up to 1.5m high, has crowded, narrow leaves (Plate 9). The small flowers are spider-like and clustered in groups of 6-12. The whole flower, both the tube and the protruding style, is white or pinkish. It suckers readily from rhizomes, which can make determining individual plants difficult.

This species is distributed sporadically within the central NSW coastal region from south of Sydney to the lower Hunter. It occurs in a range of vegetation types from heath and shrubby woodland to open forest. It generally grows in sandy or light clay soils, usually over thin shales. It often occurs in open, slightly disturbed sites such as along tracks and infrastructure easements. It is believed to be relatively resistant to infections by *Phytophthora cinnamomi* (Olde and Marriott, 1995). Most populations demonstrate a degree of vegetative spread, particularly after disturbance such as fire.

Olde and Marriott (1995) note that *G. parviflora* adapts readily to cultivation and can be grown from seeds and cuttings of half-hardened new growth in early Spring. No published information on translocation of *G. parviflora* could be located, but other species of *Grevillea* have beeen successfully translocated (e.g. Stack *et al*., 2003).

Threats include:

- loss and fragmentation of habitat associated with clearing for urban development, agriculture and road maintenance activities
- habitat degradation as a result of weed invasion, inappropriate fire regime and uncontrolled access
- maintenance of roads and infrastructure easements
- high frequency fire that may impact on recruitment or low frequency fire that may lead to competitive exclusion by other species.

A population is reserved in Werakata (formerly Lower Hunter) National Park. The Wildlife Atlas database contains 46 records of small-flower grevillea from five localities within 20 km of the proposed alignment, all in the southern section. The majority of these records are from a population about 20 km west of the alignment.

The current survey recorded a population of small-flower grevillea within a previously cleared 25 m wide powerline corridor at approximately KP 58.9. The site supported a range of low forbs, shrubs, grasses and sedges, including *Pultenaea villosa, Daviesia ulcifolia, Themeda triandra, Entolasia stricta* and *Lepidospermum laterale*. The population extended approximately 200 m along the corridor and was estimated to contain several hundred to a thousand plants. An accurate population count was not made during the initial survey as its identity was not confirmed until a specimen was sent to Royal Botanic Gardens. It was also difficult to determine the extent of individual plants as they were coppicing extensively under the current regular slashing regime. An individual plant was recorded in remnant open forest approximately 0.5 km north of the main population. It is therefore likely that other populations exist in surrounding remnant vegetation (including the nearby Wallaroo National Park).

The population is regularly slashed during maintenance works for the powerline and is transected by a maintenance track. Plants were relatively prostrate and multi-stemmed, but appeared to be otherwise healthy, with most flowering at the time of survey. Several plants were observed growing between the wheel ruts of the maintenance track.

a) Not applicable

(b) Not applicable

(c) (i) The proposed development would transect a population of small-flower grevillea for approximately 200 m. Assuming that one half of the cleared corridor will be disturbed by the proposed development, this will directly impact on several hundred plants in an area of 0.2 ha. This species is also known from one site about 0.5 km to the north (present survey) and five other localities within 20 km (Wildlife Atlas data), so the proposed development would be unlikely to increase the risk of local extinction.

(ii) Construction and maintenance works may also indirectly impact on portions of the population uncleared by the proposed development and on other populations in remnant forest adjoining the powerline easement. Impacts could include movement of sediments, nutrients and pollutants, introduction and spread of weeds and altered fire regimes. With appropriate mitigation as recommended below, the proposed development would be unlikely to modify known populations of small-flower grevillea to the extent that the risk of extinction is significantly increased.

(d) (i) The proposed development would directly impact on approximately 0.2 ha of habitat supporting small-flower grevillea. This represents approximately half of the existing population area. This habitat is currently highly modified by previous clearing and regular slashing for a powerline easement.

(ii) This species occurs in highly scattered and isolated populations throughout its range. The proposed development will impact on approximately half of one small population, so would be unlikely to lead to increased fragmentation or isolation of this species.

(iii) With appropriate mitigation as recommended below, the number of small-flower grevilleas will not decrease, so the proposed development would be unlikely to significantly reduce the long term survival of this species in the local area. In the broader area, this species is known from one site about 0.5 km to the north (present survey) and five other localities within 20 km (Wildlife Atlas data). One of these populations has 37 records over an area of 6 km by 1 km, so is likely to comprise a much larger and more important population than the newly discovered site.

(e) No critical habitat has been declared by the Director-General of the NPWS for this species.

(f) There is currently no recovery plan for this species, but DECC has identified five priority actions:

- Captive husbandry or ex-situ collection / propagation - investigate seed viability, germination, dormancy and longevity (in natural environment and in storage).
- Develop and implement protocols and guidelines - liaise with land managers to encourage the preparation of site management plans and the implementation of appropriate threat abatement measures, particularly in fire management, bush regeneration, roadside management, weed control and fencing and signage.
- Monitoring - monitor known populations, so that potential local extinctions are detected before they occur and mechanisms can be put in place to reverse trends.
- Research - Investigate genetic variation in collaboration with BGT.
- Survey / mapping and habitat assessment - Identify and survey potential habitat to detect new populations.

The mitigation strategies proposed in this report are consistent with these actions. An offset plan, if required, would provide valuable information on seed collection, propagation and establishment of this species (Action 1). A management plan would be developed for the existing population, which would contribute significantly to the development of protocols and guidelines that can be used by other land managers to manage populations of this species (Action 2). The management plan and offset plan would include ongoing monitoring of the existing population and the offset population, if required (Action 3). Surveys of the existing population and a suitable offset area, if required, would contribute to mapping and habitat assessment of this species (Action 5).

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and *Grevillea parviflora*: clearance of native vegetation and consequences of high frequency fire. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats or alter the fire regime.

Mitigation measures

Options to mitigate impacts of the proposed development may include:

- detailed survey of the small-flower grevillea population within the proposed ROW and adjacent area to determine population characteristics and assess likely impacts of the proposed development
- investigation of alternate routes to avoid or minimise impacts on the population
- liaison with relevant stakeholders and authorities (e.g. DECC, DEHWA, electrical authority that currently maintains the powerline easement) to develop an appropriate management plan (including construction and operational / maintenance phases)
- management of construction to avoid impacts on adjacent populations, including:
  - fencing of the population adjacent to the development to avoid accidental damage
  - development and implementation of appropriate sediment and erosion control systems
  - stockpiling and respreading of topsoil containing seeds of this species following construction
  - revegetation with native species as soon as possible following construction
  - development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction
- following construction, appropriate maintenance strategies will be developed and implemented to minimise ongoing impacts on the existing population (including monitoring of the population)
- avoid causing any significant changes to current fire regimes
- if part of the population must be removed, an offset strategy will be developed in consultation with DECC, including:
  - assessment of the area and number of plants that will be impacted
  - identification of an appropriate offset area where a population of this species can be established, preferably adjacent to an existing conservation area
  - propagation of sufficient plants to offset the number impacted by the proposed development (e.g. by seeds or cuttings)

- planting and maintenance of propagated plants (and translocated plants, if feasible) in the offset area for at least 2 years
- monitoring of the offset population for at least 5 years
- appropriate legislative protection of the offset area.

***Maundia triglochinoides*: Vulnerable**

Maundia triglochinoides is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. *Maundia triglochinoides* is a perennial with rhizomes about 5mm thick and emergent tufts of leaves arising along their length. Its leaves triangular in cross section, to 80 cm long, 5 – 10 mm wide. Its inflorescences are 10 cm long and 2.5 cm wide. Carpels are 6 – 8 mm long, sessile, each with a spreading beak. This species flowers from November-January.

Maundia triglochinoides is restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct.

This species grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, in areas of low nutrients. It is usually associated with other wetland species such as *Triglochin procerum*.

Maundia triglochinoides was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in coastal swamps and freshwater habitats in the project area.

Threats include:

- further loss and fragmentation of habitat
- changes in hydrology and water quality
- weed invasion.

(a) Potential habitat for *Maundia triglochinoides* may occur in the coastal swamps in the southern end of the project area. Provided that the mitigation measures listed below are implemented then the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures below are implemented, then: (i) the proposed development would result in the removal of 0.3 to 0.5 ha of wetland habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) Localised, short term alteration of wetlands will occur; however, because the alteration should only be temporary, it is unlikely to have a significant impact on the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Maundia triglochinoides.*

(f) There is currently no recovery plan or threat abatement plan for *Maundia triglochinoides*. Eight priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of wetlands is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Maundia triglochinoides*: clearance of native vegetation, alteration of the natural flow regimes and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade swamp and freshwater habitats, alter the natural flow regimes of swamps and freshwater habitats and increase the spread of weeds.

Mitigation measures

To minimise potential impacts to *Maundia triglochinoides* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Maundia triglochinoides* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Maundia triglochinoides.*

***Persicaria elatior* (Tall Knotweed): Vulnerable**

Persicaria elatior is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act.

Tall Knotweed is an erect herb to 90 cm tall, with stalked, glandular hairs (i.e. they are knobbed when seen under a lens) on most plant parts. Its leaves are up to 11 cm long and 30 mm wide. A sheath encircles the stem at the base of each leaf, which is characteristic of its plant family. Its tiny flowers are in long, narrow spikes to 5 cm long. The pink flower-segments are less than 4 mm long.

Tall Knotweed has been recorded in Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, Picton Lakes, Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests).

This species normally grows in damp places, especially beside streams and lakes. It occurs occasionally in swamp forest or associated with disturbance.

Persicaria elatior was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded beside streams and wetlands in the project area.

Threats include:

- inadvertent clearing from moist disturbed habitat
- damage to road and track populations through maintenance activities
- clearing of or hydrological changes to wetland vegetation.

(a) Potential habitat for *Persicaria elatior* may occur in wetlands and streams in the project area. Provided that the proposed development avoids impact or damage to any preferred habitat and a pre-clearance survey for conducted for individuals prior to any vegetation clearing, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures below are implemented, then: (i) the proposed development would result in the removal of approximately 1 ha of wetland habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) Localised, short term alteration of streams will occur; however, because the alteration should only be temporary, it is unlikely to have a significant impact on the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Persicaria elatior.*

(f) There is currently no recovery plan or threat abatement plan for *Persicaria elatior*. 1 priority action statement has been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and *Persicaria elatior:* clearance of native vegetation and alteration of natural flow regimes. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade stream and riparian habitats or alter the natural flow regime of streams and waterways.

Mitigation measures

To minimise potential impacts to *Persicaria elatior* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Persicaria elatior* are removed during construction.
- Minimise the amount of native vegetation to be cleared by employing the minimum construction footprint width in wetland and riparian habitats.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Persicaria elatior.*

***Pomaderris queenslandica* (Scant Pomaderris): Endangered**

Pomaderris queenslandica is listed as Endangered under the TSC Act. Scant Pomaderris is a medium-sized shrub 2 - 3m tall. The stems are whitish with tiny star-shaped hair clusters. The leaves are oval to narrow elliptical, 2.5 - 7 cm long and 10 - 25 mm wide. They are shiny on the top and woolly underneath. The small creamy yellow flowers appear during spring-summer.

Scant Pomaderris is widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolatai, and also from several locations on the NSW north coast. It is found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.

Pomaderris queenslandica was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in eucalypt forest, woodlands and along creeks in the project area.

Threats include:

- disturbance from roadworks and timber harvesting activities
- invasion by introduced weeds
- risk of local extinction because populations are isolated
- clearing of habitat for agriculture
- inappropriate fire regime.

(a The proposed development would result in the removal of potential *Pomaderris queenslandica* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures below are implemented then, (i) the proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Pomaderris queenslandica.*

(f) There is currently no recovery plan or threat abatement plan for *Pomaderris queenslandica*. Twelve priority action statements have been prepared to help recover this species (DECC, 2005). Provided that the mitigation methods listed below are implemented then, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Pomaderris queenslandica*: clearance of native vegetation, consequences of high frequency fire and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, alter the fire regime and increase weed spread.

Mitigation measures

To minimise potential impacts to *Pomaderris queenslandica* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Pomaderris queenslandica* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Avoid causing any significant changes to current fire regime.

***Rhizanthella slateri* (Eastern Underground Orchid): Vulnerable**

Rhizanthella slateri is listed as Vulnerable under the TSC Act and Endangered under the EPBC Act. *Rhizanthella slateri* is an endemic Australian orchid that has been described as a terrestrial saprophytic herb (i.e. grows on and derives its nourishment from dead or decaying organic matter) with a fleshy underground stem to 15 cm long and 15 mm in diameter. The flower heads mature below the soil surface but sometimes may extend 2 cm above the ground, and are about 2 cm in diameter. The receptacle has up to 18 bracts about 8 mm long and has up to 30 flowers which are tubular and purplish. The bracts are prominent, often branching, fleshy, whitish and overlapping.

Biologically, *Rhizanthella slateri* is of significant conservation value because of its unusual life cycle. It is one of only three Australian species, and a small number of species worldwide, that are capable of completing their entire lifecycle underground. Subterranean flowering plants such as these are extremely unusual and are of great scientific interest to biologists all over the world.

Rhizanthella slateri is restricted to New South Wales where it is currently known from fewer than 10 locations including Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The *Rhizanthella slateri* population in the Great Lakes local government area (LGA) occurs at the known northern limit of the species' range and is disjunct from other known populations of the species.

Surveys conducted between 2002 and 2005 identified approximately 75 flowerheads at a site within the Great Lakes LGA, more than ten times the number observed at any other site. The *Rhizanthella slateri* population in the Great Lakes LGA is thus likely to be the largest and most extensive known population of the species. Other known populations of *Rhizanthella slateri* are fragmented and highly disjunct, comprising isolated individuals or small clusters of plants.

Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.

The ecology of *Rhizanthella slateri* is highly obscure given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore plants are usually located only when the soil is disturbed. *Rhizanthella slateri* flowers in October and November.

Rhizanthella slateri was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in sclerophyll forests in the project area.

Threats include:

- The *Rhizanthella slateri* population in the Great Lakes LGA is threatened by a proposal to construct a road through the population. The proposal will result in the direct removal of 4% of the known population and other individuals as yet undetected may become exposed after clearing or excavation works.
- A further 34% of the known population is indirectly threatened by altered drainage and changes in soil moisture, and by weed invasion associated with the road.
- The proposed road will remove 9% of known habitat and 29% of potential habitat for the species, fragmenting the population and potentially disrupting pollination and seed dispersal.
- Orchid collectors represent a further threat to the species due to its very unusual growth form and extreme rarity, and the publicity associated with the Bulahdelah site.
- The *Rhizanthella slateri* population in the Great Lakes LGA may also be threatened by environmental and demographic stochasticity due to its restricted area and small size.

(a) Potential habitat for *Rhizanthella slateri* may occur in the project area but due to the lack of information regarding the distribution of this species it is difficult to determine whether the proposed development will adversely impact on the species' life cycle. It has been recorded from sclerophyll forest, so the proposed development may result in the removal of 16 to 25 ha of potential *Rhizanthella slateri* habitat.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures listed below are followed then: (i) only 16.7 to 25 ha of remnant vegetation will be removed, although this species may occur outside of remnant vegetation and therefore more potential habitat may be removed; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) given the lack of knowledge regarding the distribution of this species it is difficult to determine the importance of any habitat that may be removed.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Rhizanthella slateri*.

(f) There is currently no recovery plan or threat abatement plan for *Rhizanthella slateri*. No priority action statements have been prepared to help recover this species (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, three may be relevant to the proposed development and *Rhizanthella slateri*: clearance of native vegetation and removal of dead wood and dead trees and infection of native plants by *Phytophthora cinnamomi*. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise clearing, replace dead organic matter wherever possible and avoid spread of *Phytophthora cinnamomi*.

Mitigation measures

To minimise potential impacts to *Rhizanthella slateri* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should attempt to ensure that no *Rhizanthella slateri* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Ensure topsoil is stockpiled and respread as soon as possible after construction.
- Develop and implement weed and phytophthora management protocols (including hygiene and control) during and for at least two years following construction.

***Tetratheca juncea* (Black-eyed Susan)**

Tetratheca juncea is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. Black-eyed Susan is a low shrub that grows in clumps of single or multiple stems. Its flowers face downwards and usually have four petals which range from white to pink to dark purple in colour. They are borne singly or in pairs along the stem. Stems are 30 to 60 cm long, usually leafless with 2 to 3 narrow wings that give them an angular appearance. Plants are usually sprawling and can be difficult to detect amongst other vegetation when not flowering.

Tetratheca juncea is confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest / woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heatAECOMnd and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies. It usually spreads via underground stems which can be up to 50 cm long. Consequently, individual plants may be difficult to identify. It also reproduces sexually but this requires insect pollination.

Tetratheca juncea was not recorded during the field surveys. The desktop survey revealed two previous records from within a 5 km buffer of the project area. Potential habitats were recorded in the project area in open forests and woodlands with a mixed shrub understorey and grassy groundcover.

Threats include:

- habitat loss due to clearing for urban development
- habitat degradation resulting from frequent fire, weed invasion and stormwater runoff.

(a) The proposed development would result in the removal of a small amount of potential habitat (15 to 25 ha depending on construction methods). This impact is unlikely to have an adverse effect on the lifecycle of the species, provided that the proposed development minimises clearing and pre-clearance surveys are conducted.

(b) Not applicable.

(c) Not applicable.

(d) Provided that clearing is kept to a minimum then: (i) The proposed development would result in the removal of a small amount of potential habitat (15 to 25 ha depending on construction methods). (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented (iii) The habitat proposed to be modified is minimal when compared to the large area of suitable habitat in the surrounding area.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Tetratheca juncea.*

(f) There is currently no recovery plan or threat abatement plan for *Tetratheca juncea*. 11 priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Tetratheca juncea*: clearance of native vegetation, consequences of high frequency fire and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, alter the fire regime or spread weeds.

Mitigation measures

To minimise potential impacts to *Tetratheca juncea* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Tetratheca juncea* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Avoid causing any significant changes to the current fire regime.

***Zannichellia palustris*: Endangered**

Zannichellia palustris is listed as Endangered under the TSC Act. *Zannichellia palustris* is a submerged, monoecious, weakly rhizomatous, aquatic annual or perennial plant. Its leaves are 2-7 cm long and only around 1 mm wide.

In NSW, *Zannichellia palustris* is known only from the lower Hunter Region. It grows in fresh or slightly saline stationary or slowly flowing water. It flowers during warmer months and behaves as an annual, dying back completely every summer.

Zannichellia palustris was not recorded during the field surveys. The desktop survey revealed two previous records from within a 5 km buffer of the project area. Potential habitats were recorded in streams in the project area.

Threats include:

- changes to catchments resulting to changes in hydrological conditions and water quality.

(a) Potential habitat for *Zannichellia palustris* may occur in streams and wetlands in the project area. The proposed development would result in the removal of a small amount of potential habitat (approximately 1 ha). Provided that the measures for mitigating affects on hydrological flow regimes are implemented and pre-clearance surveys are conducted, then the proposed development is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) Provided that clearing is kept to a minimum then: (i) The proposed development would result in the removal of a small amount of potential habitat (about 1 ha). (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented (iii) Localised, short term alteration of streams will occur; however, because the alteration should only be temporary, it is unlikely to have a significant impact on the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Zannichellia palustris*.

(f) There is currently no recovery plan or threat abatement plan for *Zannichellia palustris*. No priority action statements have been prepared to help recover this species (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Zannichellia palustris*: Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that alter hydrological regimes and water quality in freshwater streams.

Mitigation measures

To minimise potential impacts to *Zannichellia palustris* from the proposed development, the following mitigation measures are recommended:

- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Zannichellia palustris.*
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Pre-clearance surveys should ensure that no *Zannichellia palustris* are removed during construction across streams.

Green and Golden Bell Frog (*Litoria aurea)*: Endangered

The Green and Golden Bell Frog is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. It was formerly distributed from the NSW north coast near Brunswick Heads southwards along the NSW coast to Victoria (White and Pyke, 1996; Gillespie, 1996) and the ACT (Moore, 1961; Osborne et al., 1996). Population decline has been such that today the species exists as a series of isolated coastal populations within its former known range. In recent years, surveys of known sites have failed to find any higAECOMnd populations and fears are that these populations are now extinct. Many former coastal populations have also dramatically declined or disappeared altogether (White and Pyke, 1996).

The Green and Golden Bell Frog inhabits marshes, dams and stream sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.) Optimum habitat includes water bodies which are unshaded, free of predatory fish (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available such as vegetation and / or rocks (White and Pyke, 1996). The Green and Golden Bell Frog is frequently active by day and usually breeds in summer when conditions are warm and wet (Cogger, 1992). Tadpoles feed on algae and vegetative matter and adults are voracious predators of insects and small vertebrates. Both tadpoles and frogs are preyed upon by birds, snakes and fish.

The main threats to the Green and Golden Bell Frog include:

- alteration of drainage patterns and stormwater runoff (White and Pyke, 1996)
- a fungal pathogen (Berger and Speare, 1998)
- changes to water quality (Goldingay, 1996)
- predation by feral animals such as foxes and cats (Daly, 1996)
- herbicides and other weed control measures
- road mortality where populations are already small due to other threats (Daly, 1996)
- predation by exotic fish particularly the Plague Minnow *Gambusia holbrooki* (Morgan and Buttemer, 1996)
- loss of suitable breeding habitat through alteration by infilling and destruction of wetlands (Morgan and Buttemer, 1996; Clancy, 1996).

The Green and Golden Bell Frog was not recorded during the field survey. The desktop survey revealed over 140 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area at KP 67.8.

(a) Potential habitat occurs in the project area. Of concern are the open freshwater swamps along the Williams and Hunter Rivers. However, the pipeline alignment may avoid the wetlands by redirecting the route through pastureland adjacent to the wetlands or by HDD beneath the wetland to avoid disturbance. The proposed action is therefore unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the construction footprint avoids wetlands (i) Potential habitat within the freshwater wetlands is unlikely to be modified. (ii) No fragmentation or isolation of habitat should result. (iii) No modification of potential habitat is expected.

(e) No critical habitat has been declared by the Director-General of the NPWS for Green and Golden Bell Frog.

(f) The action proposed is not inconsistent with the 33 priority action statements designed to help this species recover (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Green and Golden Bell Frog: the alteration of open freshwater wetlands. The proposed development would be unlikely to increase the susceptibility of this species through habitat alteration or destruction with appropriate mitigation as recommended below.

Mitigation measures

To minimise potential impacts to the Green and Golden Bell Frog from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on Freshwater Wetlands on Coastal Floodplains identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Construction and disturbance should be confined to dry periods (when wetland dry) as far as practical.
- Emergent vegetation (e.g. sedges, spike rushes. bulrushes and reeds) fringing the wetlands should not be damaged or modified. Any disturbed wetland areas should be revegetated as soon as possible following construction.
- Appropriate wildlife bridges, ladders and shelters shoul be installed in open trenches.
- Qualified fauna handlers should be employed to remove any trapped wildlife from the open trench each day.

Stuttering Frog (*Mixophyes balbus)*: Endangered

The Stuttering Frog is listed as Endangered on the TSC Act and Vulnerable under the EPBC Act. Stuttering Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. The species has suffered a marked decline in distribution and abundance, particularly in south-east NSW. It is the only *Mixophyes* species that occurs in south-east NSW.

The Stuttering Frog is found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and in the thick understorey vegetation on the forest floor. The frogs breed in streams during summer after heavy rain and lay eggs on rock shelves or shallow riffles in small, flowing streams. As the tadpoles grow they move to deep permanent pools and take approximately 12 months to metamorphose. The frogs prey on insects and smaller frogs.

The main threats to the Stuttering Frog include:

- modification and alteration of habitat
- changes in natural water flows and quality
- predation of eggs from introduced fish particularly the plague minnow (*Gambusia holbrooki*)
- disease (chytrid fungus).

`The Stuttering Frog was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area on the Karuah River (KP 19, 23.5 and 24.2) and dense forest at Black Camp Road (KP 36.8-36.9).

(a) Potential habitat for the Stuttering Frog may occur in the project area in the forests along Black Camp Road and the Karuah River. Provided that the proposed development avoids impact or damage to streams (i.e. by HHD under permanent streams and their riparian vegetation) it is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the construction footprint avoids impacts or modification to riparian vegetation along the Karuah River and minimises clearing of timbered habitats at Black Camp Road, then: (i) Potential habitat within the freshwater wetlands is unlikely to be modified. (ii) No fragmentation or isolation of habitat should result. (iii) No modification of potential habitat is expected.

(e) No critical habitat has been declared by the Director-General of the NPWS for Stuttering Frog.

(f) There is currently no recovery plan or threat abatement plan for the Stuttering Frog. Seven priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is consistent with all seven of these.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Stuttering Frog: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing and any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Stuttering Frog from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on streams**.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Clearance, damage or modification of riparian vegetation should be avoided, especially at the Karuah River.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats at Black Camp Road.

Giant Barred Frog (*Mixophyes iteratus*): Endangered

The Giant Barred Frog is listed as Endangered under the TSC Act and Endangered under the EPBC Act. It is found along the coast and ranges from Conondale Ranges in south-east Queensland to the Blue Mountains and western Sydney in NSW. The Coffs Harbour - Dorrigo areas are now considered to be the species stronghold where it is found in small disjunct populations.

The Giant Barred Frog can be found in rainforests, wet sclerophyll and nearby dry eucalypt forests where they utilize permanent flowing streams or slow moving rivers. Breeding takes place in late spring and summer. Eggs are laid in rocks or on the stream banks above water level, where the tadpoles will drop into the water after hatching. The tadpoles are up to 80 mm in length and can take up to 14 months to mature. They forage and live in damp and deep leaf litter. When the species is not breeding they can disperse hundreds of metres away from streams and feed on insects and spiders.

The main threats to the Giant Barred Frog include:

- predation on tadpoles and eggs by introduced fish particularly the plague minnow
- spraying of weeds along freshwater streams
- removal of leaf litter and fallen logs around freshwater streams through fire
- flow alteration to streams
- reduction in water quality through sedimentation and pollution
- timber harvesting and vegetation clearance
- the chytrid fungus.

The Giant Barred Frog was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area on the Karuah River (KP 19, 23.5 and 24.2) and dense forest at Black Camp Road (KP 36.8-36.9).

(a) Potential habitat for the Giant Barred Frog may occur in the project area in the forests along Black Camp Road and the Karuah River. Provided that the proposed development avoids impact or damage to streams (i.e. by HHD under permanent streams and their riparian vegetation) it is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the construction footprint avoids impacts or modification to riparian vegetation along the Karuah River, and minimises clearing of timbered habitats at Black Camp Road, then: (i) Potential habitat within the freshwater wetlands is unlikely to be modified. (ii) No fragmentation or isolation of habitat should result. (iii) No modification of potential habitat is expected.

(e) No critical habitat has been declared by the Director-General of the NPWS for Giant Barred Frog.

(f) There is currently no recovery plan or threat abatement plan for the Giant Barred Frog. Five priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with these priority action statements.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Stuttering Frog: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing and any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Giant Barred Frog from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on streams**.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Clearance, damage or modification of riparian vegetation should be avoided, especially at the Karuah River.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats at Black Camp Road.

Pale-headed Snake (*Hoplocephalus bitorquatus)*: Vulnerable

The Pale-headed Snake is listed as Vulnerable under the TSC Act. It is found from north-east Queensland to north-east New South Wales where they occur west of the Great Dividing Range.

Pale-headed snakes primarily inhabit dry eucalypt forests and cypress forests, although they have been recorded in rainforests and moist eucalypt forests. They are nocturnal and shelter during the day under bark on trees or in hollow limbs and trunks. They favour stream sides and prey upon tree frogs but mammals and reptiles will be taken.

The main threats to the Pale-headed Snake include:

- clearing and fragmentation of habitat
- inappropriate fire regimes that remove understorey and dead trees
- illegal removal of individuals.

The Pale-headed Snake was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered sections of the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. These areas are expected to support higher densities of hollow-bearing trees. The action will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Pale-headed Snake.

(f) There is currently no recovery plan or threat abatement plan for the Pale-headed Snake. Eight priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with these.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Pale-headed Snake: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Pale-headed Snake from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible;
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Stephens' Banded Snake (*Hoplocephalus stephensii)*: Vulnerable

The Stephen's Banded Snake is listed as Vulnerable under the TSC Act. It occurs along the coast and ranges from southern Queensland to northern New South Wales. It inhabits a range of habitats including rainforest, wet sclerophyll forest and dry sclerophyll forest up to 950 m in altitude.

Stephen's Banded Snake is arboreal and shelters under loose bark on trees, in vines, among epiphytes and in rock crevices. It is nocturnal and feeds mainly on lizards, frogs, mammals and birds.

The main threats to the Stephen's Banded Snake include:

- habitat fragmentation
- alteration and clearing
- inappropriate fire regimes that remove vegetation
- illegal removal from natural habitats.

The Stephen's Banded Snake was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered sections of the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. These areas are expected to support higher densities of hollow-bearing trees. The action will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Stephen's banded Snake.

(f) There is currently no recovery plan or threat abatement plan for the Stephen's Banded Snake. Thirteen priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with these.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Stephen's Banded Snake: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Stephen's Banded Snake from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Magpie Goose (*Anseranas semipalmata)*: Vulnerable

The Magpie Goose is listed as Vulnerable under the TSC Act. Magpie Goose is still relatively common in the Australian tropics, but had disappeared from south-east Australia by 1920 due to drainage and overgrazing of reed swamps used for breeding. Since the 1980s, there have been an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW.

It is mainly found in shallow wetlands (60-100 cm deep) with dense growth of rushes or sedges. It is equally at home in aquatic or terrestrial habitats, where it is often seen walking and grazing on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off. Breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level. Most breeding now occurs in monsoonal areas and is unlikely in south-eastern NSW. Nests are formed in trees over deep water. It is often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains. It roosts in tall vegetation such as trees that are dead or alive.

The main threats to this species include:

- inappropriate hydrological regimes of wetland habitats through drainage of swamps, ponds, dams and other wetlands for agricultural and other human purposes
- degradation of habitat through water pollution (e.g. salinity, chemicals, eutrophication)
- modification of habitat and nest loss from trampling and overgrazing
- predation on eggs and goslings
- too-frequent burning of wetlands.

Magpie Goose was not recorded during the field survey. The desktop survey revealed 17 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetland habitats in the study area.

(a) Provided that the proposed development avoids impacts to wetlands and does not lead to the removal of roost trees near wetlands, it will not place a viable local population of this species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands, it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not affect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Magpie Goose (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Magpie Goose (DECC, 2005). There are 14 priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Magpie Goose: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; clearance of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Magpie Goose from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Native vegetation fringing the wetlands identified in **Section 3.4.2** should not be cleared.
- Dead wood and dead trees near the wetlands identified in **Section 3.4.2** should not be removed.

Australasian Bittern (*Botaurus poiciloptilus)*: Vulnerable

The Australasian Bittern is listed as Vulnerable under the TSC Act. Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west.

Australasian Bitterns favour permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.). They hide during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird. Platforms are often littered with prey remains. Breeding occurs in summer from October to January. Nests are built in secluded places in densely-vegetated wetlands on a platform of reeds. Clutches usually contain six olive-brown eggs.

The main threats to the species include:

- drainage of wetlands and ponds
- reduced water quality due to siltation, pollution and salinity
- predation by foxes and cats
- use of herbicides, pesticides and other chemicals near wetland areas
- grazing and associated frequent burning of wetland areas.

Australasian Bittern was not recorded during the field survey. The desktop survey revealed six previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in open wetland habitats in the study area.

(a) Provided that the proposed development avoids impacts to wetlands and fringing vegetation of wetlands, then it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Australasian Bittern (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Australasian Bittern (DECC, 2005). There are eight priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Australasian Bittern: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; and clearance of native vegetation. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Australasian Bittern from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Emergent vegetation (e.g. sedges, spike rushes, Bulrushes and reeds) fringing the wetlands identified in **Section 3.4.2** should not be damaged or modified. Any disturbed wetland areas should be revegetated as soon as possible following construction.

Black Bittern (*Ixobrychus flavicollis)*: Vulnerable

The Black Bittern is listed as Vulnerable under the TSC Act. Black Bitterns have a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.

It inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. It feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, it roosts in trees or on the ground amongst dense reeds. It is generally solitary, but occurs in pairs during the breeding season, from December to March. Like other bitterns, but unlike most herons, nesting is solitary. Nests are built in spring. They are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. Between three and five eggs are laid and both parents incubate and rear the young.

The main threats to this species include:

- clearing of riparian vegetation
- predation by foxes and feral cats on eggs and juveniles
- grazing and trampling of riparian vegetation by stock.

The Black Bittern was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetlands and riparian habitats in the study area.

(a) Provided that the proposed development avoids impacts to wetlands and riparian vegetation, it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands and riparian vegetation, it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Black Bittern (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Black Bittern (DECC, 2005). There are two priority action statements designed to help this species recover (DECC, 2005). Of relevance is the requirement to retain and manage riparian vegetation. Provided that the proposed development avoids removal of riparian vegetation (especially along the Karuah River) then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, two are is relevant to the proposed development and the Black Bittern: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Black Bittern from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- The development footprint should avoid encroaching or impacting on streams. This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Clearance, damage or modification of riparian vegetation should be avoided, especially at the Karuah River.

Black-necked Stork (*Ephippiorhynchus asiaticus)*: Endangered

The Black-necked Stork is listed as Endangered under the TSC Act. Black-necked Storks are widespread across coastal northern and eastern Australia, becoming increasingly uncommon further south into NSW, and rarely south of Sydney. Some birds may move long distances and can be recorded well outside their normal range.

The Black-necked Stork inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands. It can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. It feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes. It breeds in late summer in the north, and early summer further south. A large nest, up to 2 m in diameter, is made in a live or dead tree, in or near a freshwater swamp.

The main threats to this species include:

- loss of wetland habitat through clearing and draining for flood mitigation, agriculture and residential development
- degradation of wetland habitats through pollution and salinisation
- modification of natural wetlands through changes in natural water flow regimes.

Black-necked Stork was not recorded during the field survey. The desktop survey revealed 81 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetland habitats within the study area.

(a) Provided that the proposed development avoids impacts to wetlands and does not lead to the removal or damage of a nest tree, then it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Black-necked Stork (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Black-necked Stork (DECC, 2005). There are 14 priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Black-necked Stork: Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Black-necked Stork from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Native vegetation fringing the wetlands identified in **Section 3.4.2** should not be cleared.
- Dead wood and dead trees near the wetlands identified in **Section 3.4.2** should not be removed.
- Pre-clearance surveys should identify nest trees in the vicinity of wetlands that are close to the development footprint to ensure that no nest trees are inadvertently removed or damaged.

Comb-crested Jacana (*Irediparra gallinacea)*: Vulnerable

The Comb-crested Jacana is listed as Vulnerable under the TSC Act. They occur throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW. It inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies. Pairs and family groups forage across floating vegetation, walking with a characteristic bob and flick, or flying low with toes dangling behind. They feed primarily on insects and other invertebrates, as well as some seeds and other vegetation. It breeds in spring and summer in NSW, in a nest of floating vegetation. The male builds the nest, incubates the eggs and broods the young. Females defend up to four mated males and their territories (the floating vegetation around their nest) from other females. Young birds will dive and stay submerged with just their nostrils exposed for a very long time. Adults will also dive for safety on occasion.

The main threat to the species is loss of wetland habitat through clearing and draining for flood mitigation and agriculture (DECC, 2005).

Comb-crested Jacana was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetlands within the study area.

(a) Provided that the proposed development avoids impacts to wetlands then it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Comb-crested Jacana (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Comb-crested Jacana (DECC, 2005). There are eight priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Comb-crested Jacana: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Comb-crested Jacana from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.

Painted Snipe (*Rostratula benghalensis)*: Endangered

The Painted Snipe is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act**.** In NSW the Painted Snipe has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. It is most common in the Murray-Darling Basin. It prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. It nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions and generally occurs from September to December. It forages nocturnally on mud-flats and in shallow water for worms, molluscs, insects and some plant matter.

The main threats to this species include:

- drainage of breeding sites in wetlands
- reduced water quality from siltation and pollution
- predation by foxes and feral cats
- use of herbicides, insecticides and other chemicals near wetlands
- grazing and associated frequent burning of wetlands.

Painted Snipe was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetlands within the study area.

(a) Provided that the proposed development avoids impacts to wetlands and surrounding vegetation, then it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands and surrounding vegetation, then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Painted Snipe (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Painted Snipe (DECC, 2005). There are two priority action statements designed to help this species recover (DECC, 2005). Neither of these have relevance to the proposed development.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Painted Snipe: Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; clearance of native vegetation; and removal of dead wood. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Painted Snipe from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Emergent vegetation (e.g. sedges, spike rushes. bulrushes and reeds) fringing the wetlands identified in **Section 3.4.2** should not be damaged or modified.
- Native vegetation fringing the wetlands identified in **Section 3.4.2** should not be cleared.
- Dead wood and dead trees near the wetlands identified in **Section 3.4.2** should not be removed.

Bush Stone-curlew (*Burhinus grallarius)*: Endangered

The Bush Stone-curlew is listed as Endangered under the TSC Act. They are found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. However, it is common only in northern Australia. In the south-east, it is either rare or extinct throughout its former range.

It inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. It is largely nocturnal, being especially active on moonlit nights. The main food is insects and small vertebrates, such as frogs, lizards and snakes. The species nests on the ground in a scrape or small bare patch, during spring and early summer.

The main threats to the Bush Stone-curlew include:

- predation by foxes and cats
- trampling of eggs by cattle
- clearance of woodland habitat for agricultural and residential development
- modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, grazing and frequent fires
- disturbance in the vicinity of nest sites.

The Bush Stone-curlew was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging and breeding habitat (15 to 35 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Bush Stone-curlew (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Bush Stone-curlew (DECC, 2005). There are ten priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Bush Stone-curlew: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Bush Stone-curlew from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearing surveys should ensure that no nests are located in the path of construction equipment.

Glossy Black-Cockatoo (*Calyptorhynchus lathami)*: Vulnerable

The Glossy Black-Cockatoo is listed as Vulnerable under the TSC Act. It occurs in a wide coastal band from central Queensland to the Victorian border, with an isolated population occurring in South Australia on Kangaroo Island (NPWS, 1999c). In NSW, the species' distribution is patchy and localised reflecting the distribution of its moist and dry sclerophyll forest habitat. This species is locally nomadic, with small family parties (seldom more than ten individuals) roaming in search of feeding areas (NPWS, 1999c). It prefers woodland dominated by *Allocasuarina* or open sclerophyll forest or woodlands with a middle stratum of *Allocasuarina*, but also occurs in busAECOMnd remnants in agricultural and urban areas (Higgins, 1999). However, the species appears to occur in peak abundance in old growth forest.

Glossy Black-Cockatoos are considered ecological specialists, feeding almost exclusively on the seeds of Forest Oak *Allocasuarina torulosa*, Drooping She-oak *A. verticillata* and Black She-oak *A. littoralis*, although they also occasionally eat the seeds of Swamp Oak *Casuarina glauca* and Shrub She-oak *A. distyla*. In eastern NSW, Black She-oak *A. littoralis* is the main dietary component (Chapman, 1999). Glossy Black-Cockatoos are also highly selective about which trees they feed from.

They have been recorded feeding signs beneath only 24% of the 1672 cone-bearing trees examined near Eden in NSW. Mature, sparse trees between 2-10 m tall are favoured for foraging (Higgins, 1999), with birds showing a preference for trees with large seeds and with high seed mass / cone mass ratios and high seed mass per cone values (Pepper, 2000). Although trees are selected on the basis of the number of cones, feeding activity is unevenly distributed between trees, with birds settling for sustained feeding (> 4 hrs) in some trees and remaining for only a few minutes in others. They also select only the young russet cones (rather than older grey cones) which may reflect a preference for softer cones or the higher protein content of the seeds.

The Glossy Black-Cockatoo must forage for many hours every day to obtain sufficient food and apparently suitable habitat will not always provide adequate food to support the cockatoos, in particular during the breeding season (Garnett and Crowley, 2000). Breeding birds forage for about 80% of daylight hours, consuming seeds from up to 140 cones during this period. Non-breeding birds forage for about half the daylight hours and eat half as many cones (Chapman, 1999).

Large hollows in the trunk or limbs of living or dead eucalypt trees are required for nesting. Glossy Black-Cockatoos prefer deep (40-120 cm) nest hollows with wide entrances (approximately 21 cm) located 10-28 m above the ground (Higgins, 1999). Hollows of sufficient size for nesting generally do not form in eucalypt trees less than 150-200 years old (Mackowski, 1984).

Glossy Black-Cockatoos form strong pair bonds and are thought to pair for life (Chapman, 1999). Adults breed during the autumn and winter (NPWS, 1999c), mainly between February and April but as early as January and as late as August if earlier nesting attempts fail (Chapman, 1999). Incubation of eggs lasts for about 30 days and chicks fledge around 90 days after hatching. Only one young is raised per season.

These birds are mainly sedentary but are capable of travelling large distances to locate suitable foraging habitat. Permanent groups of up to ten individuals are formed. Roosting is usually communal in the canopy of live leafy trees (Higgins, 1999) and groups may form aggregations at food and water sources.

This species is threatened by a number of processes including reduction of suitable habitat through clearing for development, loss of tree hollows, excessively frequent fire which reduces the abundance and recovery of she-oaks, and illegal bird smuggling and egg-collecting (DECC, 2005).

The Glossy Black-cockatoo was not recorded during the surveys. The desktop survey revealed eight previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas within the study area. However, these areas are considered marginal habitat because the project footprint does not intersect any areas of forest where *Allocasuarina* species are dominant.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and larger numbers of *Allocasuarina* trees occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost (15 to 35 ha) is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Glossy Black-cockatoo.

(f) There is currently no recovery plan or threat abatement plan for the Glossy Black-cockatoo (DECC, 2005). There are nine priority action statements designed to help this species recover. The proposed development is not inconsistent with these (DECC, 2005).

(g) Key threatening processes of relevance to the Glossy Black-cockatoo include the clearing of native vegetation, loss of hollow-bearing trees and excessively frequent fire (DECC, 2005). The proposed development would result in the clearing of native vegetation, resulting in a small loss of foraging habitat, and loss of potential breeding habitat such as hollow-bearing trees. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests. Furthermore, the proposed development would not increase the frequency of fires in the study area.

Mitigation measures

To minimise potential impacts to the Glossy Black-Cockatoo from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.

Gang-gang Cockatoo (*Callocephalon fimbriatum)*: Vulnerable

The Gang-gang Cockatoo is listed as Vulnerable under the TSC Act. It ranges from southern Victoria through to central eastern New South Wales (DECC, 2005). In New South Wales, the Gang-gang Cockatoo is distributed from the southeast coast to the Hunter region, and inland to the Central Tablelands and South West slopes (DECC, 2005). It occurs regularly in the Australian Capital Territory, but is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (DECC, 2005).

The Gang-gang Cockatoo is sedentary or seasonally nomadic, but partly migratory in autumn to spring. It occurs singly and in pairs to small flocks. It is found in tall mountain forest and woodlands, especially mature wet sclerophyll forests in summer. In winter, it moves to lower altitudes where it occupies drier, more open eucalypt forests and woodlands (particularly box-ironbark assemblages or dry coastal forest) and urban areas (DECC, 2005).

The Gang-gang Cockatoo favours vegetation with old growth elements for nesting and roosting. Birds nest in large hollows in the trunk or limbs of living or dead eucalypt trees (Gibbons and Lindenmayer, 2002). Hollows of sufficient size generally do not form in eucalypt trees less than 150 to 200 years old (Mackowski, 1984). Breeding usually occurs between October and January, and individuals are likely to breed from around four years of age (DECC, 2005).

It feeds mainly on the fruits of eucalypts and acacias but will feed on other seeds and fruit such as *Callitris*, garden fruits, hawthorn and *Callistemon* as well as some insects and their larvae.

This species is threatened by a number of processes including clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). Degradation of habitat may reduce the abundance of optimal foraging and roosting habitat, and climate change may alter the extent and nature of its preferred habitat (cool temperate vegetation) (DECC, 2005). Other threats include frequent fire which poses a threat to continued successful breeding, and the susceptibility of this species to *Psittacine ciroviral* disease (PCD), which is spread through contaminated nest chambers (DECC, 2005). PCD is known to have increased near Bowral in the southern higAECOMnds of New South Wales over the past decade (DECC, 2005).

The Gang-gang Cockatoo was not recorded during the surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. These areas are expected to support higher densities of hollow-bearing trees. The action will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost (15 to 35 ha) is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Gang-gang Cockatoo (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Gang-gang Cockatoo. Eight priority action statements have been prepared to help recover this species (DECC, 2005). One of these recommends the provision of supplementary hollows / nest boxes within primary habitat areas. Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with all eight priority action statements.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Gang-gang Cockatoo: the clearing of native vegetation; loss of hollow-bearing trees; and infection by *Psittacine circoviral* (beak and feather) disease, which affects parrots (DECC, 2005). The actions proposed will result in the clearing of native vegetation and possibly the loss of a number of hollow-bearing trees, resulting in a small loss of foraging habitat and potential breeding habitat. This species is not expected to be reliant on this marginal vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests. The proposed development will not increase the susceptibility of this species to infection by *Psittacine circoviral* disease. This disease is widespread and occurs naturally in Australia, with transmission occurring orally or in faeces or feathers.

Mitigation measures

To minimise potential impacts to the Gang-gang Cockatoo from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.

Swift Parrot (*Lathamus discolor)*: Endangered

The Swift Parrot is listed as Endangered under the TSC Act and Endangered under the EPBC Act. Breeding occurs in Tasmania before migration to the Australian mainland in March and October (DECC, 2005). Birds disperse widely across south-eastern Australia but are largely confined to the box-ironbark forest and woodland on the inland slopes of the Great Dividing Range, where they forage on winter-flowering eucalypts, such as *Eucalyptus robusta* (Swamp Mahogany), *Corymbia maculata* (Spotted Gum), *C. gummifera* (Red Bloodwood), *E. sideroxylon* (Mugga Ironbark), and *E. albens* (White Box) (DECC, 2005). Their diet includes nectar, pollen and lerps, but the fruits and seeds of native and exotic plants are eaten in suburban environments. Commonly used lerp-infested trees include *E. microcarpa* (Grey Box), *E. moluccana* (Grey Box) and *E. pilularis* (Blackbutt).

The Swift Parrot is threatened by a number of factors on the mainland, including loss of habitat through clearing for agriculture, and urban and industrial development (DECC, 2005). Collisions with wire netting fences, windows and cars, during the breeding season and winter migration (especially where such obstacles are in close proximity to suitable habitat) are also a major problem (DECC, 2005).

The Swift Parrot was not recorded during the surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging habitats were recorded in timbered areas within the study area. The breeding range is confined to Tasmania.

(a) The proposed development would result in the removal of a small amount of foraging habitat (15 to 35 ha depending on construction methods) in narrow strips. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. A local population of this species does not exist in the study area (they are non-breeding migrants to mainland Australia during May and August), and the proposed development will not place this species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of a small amount of foraging habitat (15 to 35 ha depending on construction methods) in narrow strips, including potential food trees. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like the Swift Parrot. (iii) The proposed loss of habitat is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Swift Parrot.

(f) There is currently no recovery plan or threat abatement plan for the Swift Parrot (DECC, 2005). There are ten priority action statements designed to help this species recover (DECC, 2005). The proposed development is not inconsistent with these.

(g) Key threatening processes of relevance to the Swift Parrot includes the clearing of native vegetation (DECC, 2005). The proposed development will result in the clearing of native vegetation, and therefore a small loss of foraging habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests.

Mitigation measures

To minimise potential impacts to the Swift Parrot from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.

Turquoise Parrot (*Neophema pulchella)*: Vulnerable

The Turquoise Parrot is listed as Vulnerable under the TSC Act. The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. It lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland, where it is usually seen in pairs or small flocks. However, it has also been reported in flocks of up to thirty individuals. It prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. It forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. Turquoise Parrots nest in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.

Threats to the species include:

- clearing of grassy-woodland and open forest habitat
- loss of hollow-bearing trees
- degradation of habitat through heavy grazing, firewood collection and establishment of exotic pastures
- predation by foxes and cats
- illegal trapping of birds and collection of eggs which also often results in the destruction of hollows.

Turquoise Parrot was not recorded during the field survey. The desktop survey revealed four previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Turquoise Parrot (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Turquoise Parrot (DECC, 2005). There are ten priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Turquoise Parrot: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Turquoise Parrot from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Hooded Robin (*Melanodryas cucullata)*: Vulnerable

The Hooded Robin is listed as Vulnerable under the TSC Act. The south-eastern form of the Hooded Robin is found from Brisbane to Adelaide throughout much of inland NSW, with the exception of the north-west. It is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible.

It prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. It requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. It often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.

The main threats to this species include:

- clearing of woodlands, resulting in loss and fragmentation of habitat
- modification and destruction of ground habitat through heavy grazing and compaction by stock, removal of litter and fallen timber, introduction of exotic pasture grasses and frequent fire.

Hooded Robin was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Hooded Robin (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Hooded Robin (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Hooded Robin: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Hooded Robin from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Speckled Warbler (*Pyrrholaemus saggitatus)*: Vulnerable

The Speckled Warbler is listed as Vulnerable under the TSC Act. It has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100 ha survive.

The Speckled Warbler lives in a wide range of eucalypt-dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat includes scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.

Speckled Warblers often join mixed species feeding flocks in winter, with other species such as Yellow-rumped, Buff-rumped, Brown and Striated Thornbills.

Threats to the species include:

- due to the fragmented nature of the populations and their small size the species is susceptible to catastrophic events and localised extinction
- clearance of remnant grassy woodland habitat for paddock management reasons and for firewood
- poor regeneration of grassy woodland habitats
- modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, heavy grazing and compaction by stock and frequent fire
- habitat is lost and further fragmented as land is being cleared for residential and agricultural developments. In particular, nest predation increases significantly, to nest failure rates of over 80%, in isolated fragments
- nest failure due to predation by native and non-native birds, cats, dogs and foxes particularly in fragmented and degraded habitats.

Speckled Warbler was not recorded during the field survey. The desktop survey revealed five previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Speckled Warbler (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Speckled Warbler (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Speckled Warbler: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Speckled Warbler from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Diamond Firetail (*Stagonopleura guttata)*: Vulnerable

The Diamond Firetail is listed as Vulnerable under the TSC Act. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. It is not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW. It is found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. It also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. It is often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. This species feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). It is usually encountered in flocks of between 5 to 40 birds, occasionally more. Groups separate into small colonies to breed, between August and January. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. These birds roost in dense shrubs or in smaller nests built especially for roosting. The species appears to be sedentary, though some populations move locally, especially those in the south. It has been recorded in some towns and near farm houses.

Threats to this species include:

- clearing and fragmentation of woodland, open forest, grassland and mallee habitat for agriculture and residential development, and firewood collection
- poor regeneration of open forest and woodland habitats
- invasion of weeds, resulting in the loss of important food plants
- modification and destruction of ground- and shrub layers within habitat through: removal of native plants, litter and fallen timber; introduction of exotic pasture grasses; heavy grazing and compaction by stock; and frequent fire
- predation of eggs and nestlings by increased populations of native predators such as the Pied Currawong *Strepera graculina*.

Diamond Firetail was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Diamond Firetail (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Diamond Firetail (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Diamond Firetail: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Diamond Firetail from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Brown Treecreeper (*Climacteris picumnus)*: Vulnerable

The Brown Treecreeper is listed as Vulnerable under the TSC Act. It is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. The eastern subspecies lives in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys.

The population density of this subspecies has been greatly reduced over much of its range, with major declines recorded in central NSW and the northern and southern tablelands. Declines have occurred in remnant vegetation fragments smaller than 300 ha, that have been isolated or fragmented for more than 50 years.

It is found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range. It mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. It is also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses. It is usually not found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging. It is also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.

It is sedentary, considered to be resident in many locations throughout its range. It may be present and territorial all year-round at many sites, although some birds may disperse locally after breeding. Hollows in standing dead or live trees and tree stumps are essential for nesting.

They are gregarious and are usually observed in pairs or small groups of eight to 12 birds. They are terrestrial and arboreal in about equal proportions. They are active, noisy and conspicuous while foraging on trunks and branches of trees and amongst fallen timber. They spend much more time foraging on the ground and fallen logs than other treecreepers. When foraging in trees and on the ground, they peck and probe for insects, mostly ants, amongst the litter, tussocks and fallen timber, and along trunks and lateral branches. Up to 80% of the diet is comprised of ants, with other invertebrates (including spiders, insects larvae, moths, beetles, flies, hemipteran bugs, cockroaches, termites and lacewings) making up the remaining percentage. Other food items may include nectar from Mugga Ironbark (*E. sideroxylon*) and paperbarks, sap from an unidentified eucalypt, lizards and food scraps (DECC, 2005).

Threats to the species include:

- loss of ground litter from compaction and overgrazing
- fragmentation of woodland and forest remnants which isolates populations and causes local extinctions
- ongoing degradation of habitat, particularly the loss of tree hollows and fallen timber from firewood collection and overgrazing.

Brown Treecreeper was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Brown Treecreeper (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Brown Treecreeper (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Brown Treecreeper: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Brown Treecreeper from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Grey-crowned Babbler (*Pomatostomus temporalis)*: Vulnerable

The Grey-crowned Babbler is listed as Vulnerable under the TSC Act. It is found throughout large parts of northern Australia and in south-eastern Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. The Grey-crowned Babbler inhabits open forest and woodland, acacia shrubland and adjoining farmland (Garnett and Crowley, 2000), foraging for invertebrates on the trunks and branches of eucalypts and other woodland trees or on the ground amongst litter and tussock grasses (DECC, 2005). It inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (DECC, 2005).

Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one, so they are generally unable to cross large open areas. Habitat fragmentation reduces breeding success as suitably sized family parties are unable to be maintained and the species eventually disappears from fragments (Garnett and Crowley, 2000).

They live in family groups of up to 15 birds that consist of a breeding pair and young from previous breeding seasons. They build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones. Grey-crowned Babblers breed between July and February. Territories range from 1 to 50 hectares (usually around 10 hectares) and are defended all year (DECC, 2005).

The main threats to the Grey–crowned Babbler include:

- clearing of woodland remnants
- heavy grazing and removal of coarse, woody debris within woodland remnants
- nest predation by species such as ravens and butcherbirds may be an issue in some regions where populations are small and fragmented.

Grey–crowned Babbler was recorded three times during the field survey at KP4, 36.9 and KP 39.5. It is also reported to be common in parts of the GFDA (T. Laurie, AGL, pers. comm.). The desktop survey revealed 63 previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Grey-crowned Babbler (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Grey-crowned Babbler (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Grey-crowned Babbler: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Grey-crowned Babbler from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Regent Honeyeater (*Xanthomyza phrygia*): Vulnerable

The Regent Honeyeater is listed as Endangered under the TSC Act and Endangered under the EPBC Act. The range has declined dramatically, with its distribution extremely disjointed and a total population believed to contain fewer than 1,500 individuals (NPWS, 1999d). There are only three known key breeding regions remaining: northeast Victoria (Chiltern-Albury) and in NSW at Capertee Valley and the Bundarra-Barraba region (DECC, 2005). In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. However, in some years non-breeding flocks converge on flowering coastal woodlands and forests (DECC, 2005), including the Hunter Valley (Higgins, 2001).

Regent Honeyeaters occur in eucalypt woodlands and open forest. Most records of the species are from box-ironbark eucalypt forest and woodland, lowland coastal forests that are dominated by Swamp Mahogany (*Eucalyptus robusta*) and Spotted Gum (*Corymbia maculata*) and riparian forests of River She-oak (DECC, 2005). These woodlands have large numbers of mature trees, high canopy cover and an abundance of mistletoes (DEC, 2005). Bird movements are thought to be dependent on spatial and temporal flowering and other resource patterns (DECC, 2005).

Nectar comprises the main diet of Regent Honeyeaters, with 16 species of eucalypt and two species of mistletoe browsed. However, three species of eucalypt make up the predominant nectar sources: Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*) and Yellow box (*Eucalyptus melliodora*) (Webster and Menkhorst, 1992).

Lerps and honeydew comprise a large proportion of the diet when nectar is scarce. Insects comprise a smaller dietary component but are important for nestlings (DECC, 2005).

Breeding occurs between July and January in Box-Ironbark and temperate woodlands and riparian gallery forest dominated by River She-oak (DECC, 2005). Nests are frequently located in Red Ironbark and River Red Gum but may also be in other eucalypts, mistletoe clumps and casuarinas (DECC, 2005).

This species is threatened by a number of processes including:

- fragmentation and degradation of habitat, key habitat tree species and remnant woodlands from clearing for agricultural, residential development, and timber gathering (particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands - DECC, 2005)
- overgrazing that suppresses the regeneration of overstorey tree species and shrub species (especially riparian gallery forests - DECC, 2005)
- competition from larger aggressive honeyeaters (e.g. Noisy Miners, Noisy Friarbirds, Red Wattlebirds)
- egg/nest predation by native birds (DECC, 2005).

The Regent Honeyeater was not recorded during the current surveys. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and nesting habitats were not recorded in the study area. The project site is outside the known breeding range and none of the winter-flowering eucalypts that characterise the wintering areas were recorded in the proposed development footprint.

(a) The proposed development would only result in the removal of a small amount of timbered habitats (15 to 35 ha, depending on construction methods). This would not include any of the favoured winter-flowering eucalypt species. The proposed development footprint is outside the known breeding range so would not impact or disturb any known breeding sites, and therefore will not adversely affect the life cycle of the species, such that a viable local population will be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha of timbered habitat; however, this does not include favoured winter-flowering eucalypts. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat loss (15 to 35 ha) is minimal when considering the large areas of preferable undisturbed habitat in the surrounding ranges and forests. The habitat is not a known breeding area, and this species is not expected to be reliant on habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Regent Honeyeater.

(f) There is currently no recovery plan or threat abatement plan for the Regent Honeyeater (DECC, 2005). There are 32 priority action statements designed to help this species recover (DECC, 2005). The proposed development is not inconsistent with these.

(g) Key threatening processes of relevance to the Regent Honeyeater includes the clearing of native vegetation (DECC, 2007). The proposed development would result in the clearing of native vegetation, resulting in a small loss of timbered habitat. This species is not expected to be reliant on this vegetation due to the absence of winter-flowering eucalypt species.

Mitigation measures

To minimise potential impacts to the Regent Honeyeater from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.

Black-chinned Honeyeater (*Melithreptus gularis)*: Vulnerable

The Black-chinned Honeyeater is listed as Vulnerable under the TSC Act. The eastern subspecies of Black-chinned Honeyeater is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, except for the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.

It occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*) and Forest Red Gum (*E. tereticornis*). It also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. Feeding territories are large, making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 ha. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage.

Threats to the species include:

- clearing of remnant open forest and woodland habitat
- poor regeneration of open forest and woodland habitats because of intense grazing
- exclusion from smaller remnants by aggressive species such as the Noisy Miner (*Manorina melanocephala*).

Black-chinned Honeyeater was not recorded during the field survey. Two previous records from within 5 km of the project site were revealed by the desktop survey. These are from woodland west of Beresford, which is to the west of the southern end of the proposed pipeline route and outside the proposed construction footprint. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Black-chinned Honeyeater (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Black-chinned Honeyeater (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Black-chinned Honeyeater: clearing of native vegetation. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Black-chinned Honeyeater from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.

Barred Cuckoo-shrike (*Coracina lineata)*: Vulnerable

The Barred Cuckoo-Shrike is listed as Vulnerable under the TSC Act. It occurs in coastal eastern Australia from Cape York to the Manning River in NSW, so its usual range is to the north of the study area. Barred Cuckoo-shrikes are generally uncommon in their range, and are rare in NSW. The species' main habitat is in rainforest areas, however, it also inhabits eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses (DECC, 2005). The species mainly forages in rainforest, feeding on seeds and fruit, swallowing them whole. The Barred Cuckoo-shrike breeds from October to January, nesting in horizontal forks of trees, 15 to 25 m above the ground.

Barred Cuckoo-shrike was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in densely timbered areas at Black Camp Rd and Karuah River. However, the species' usual range is from the Manning River north, which is north of the subject site.

(a) The subject site is to the south of the species usual range, so no viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Since the subject site is south of the usual range of the species, the proposed development will not impact on important habitat for the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Barred Cuckoo-shrike.

(f) There is currently no recovery plan or threat abatement plan for the Barred Cuckoo-shrike (DECC, 2005). There are two priority action statements (DECC, 2005) of which one is relevant to the current proposal: retain areas of native forest particularly along roads and watercourses on private land, state forests and local government areas. Provided that clearance of vegetation is kept to a minimum, particularly riparian vegetation along the Karuah River, the proposed development will not be inconsistent with this priority action.

(g) The proposed development will not contribute to a key threatening process that is relevant to Barred Cuckoo-shrike.

Mitigation measures

In accordance with the priority action statements for the species (DECC, 2005), the works should aim to minimise clearance of native vegetation, especially streamside (riparian) vegetation and road-side corridors. These mitigation actions are most relevant to the riparian vegetation along the Karuah River and the more southerly sections of forest on Black Camp Road.

Square-tailed Kite (*Lophoictinia isura*): Vulnerable

The Square-tailed Kite is listed as Vulnerable under the TSC Act. It ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.

It is found in a variety of timbered habitats including dry woodlands and open forests. It shows a particular preference for timbered watercourses. It is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Apparently, it occupies very large hunting ranges of more than 100 km^2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.

Threats to the species include:

- clearing, logging, burning, and grazing of habitats resulting in a reduction in nesting and feeding resources
- disturbance to or removal of potential nest trees near watercourses
- illegal egg collection and shooting.

Square-tailed Kite was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Square-tailed Kite (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Square-tailed Kite (DECC, 2005). There are three priority action statements designed to help this species recover (DECC, 2005). One of these (to Identify and protect nest trees, and monitor reproduction) is relevant to the proposal. Pre-clearance surveys should ensure that no trees containing nests of Square-tailed Kite are removed during construction.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Square-tailed Kite: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Square-tailed Kite from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Pre-clearance surveys should ensure that no trees containing nests of Square-tailed Kite are removed during construction.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Barking Owl (*Ninox connivens)*: Vulnerable

The Barking Owl is listed as Vulnerable under the TSC Act. It is found throughout Australia except for the central arid regions and Tasmania. It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests.

It usually inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day it roosts along creek lines, usually in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or the dense clumps of canopy leaves in large Eucalypts.

It feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Barking Owls live alone or in pairs. Territories range from 30 to, 200 hectares and birds are present all year. Breeding occurs during late winter and early spring. Three eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (E*. albens*), Red Box (*E. polyanthemos*) and Blakely's Red Gum (*E. blakelyi*).

The main threats to the species include:

- clearing and degradation of habitat, mostly through cultivation, intense grazing and the establishment of exotic pastures
- inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees
- firewood harvesting resulting in the removal of old trees
- too-frequent fire which causes degradation of understorey vegetation and reduces habitat and foraging substrate for prey species.

Barking Owl was not recorded during the field survey. The desktop survey revealed three previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Barking Owl (DECC, 2005).

(f) A *Draft Recovery Plan for the Barking Owl* (NPWS, 2003) contains 5 objectives. Specific Objective 3 requires the undertaking of threat abatement and mitigation, which requires the protection of habitat and especially large hollow-bearing trees. There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Barking Owl: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Barking Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without pre-clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Powerful Owl (*Ninox strenua*): Vulnerable

The Powerful Owl is listed as Vulnerable under Schedule 2 of the TSC Act. It is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria and occurs at low densities (DECC, 2005). In NSW it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains (DECC, 2005).

Powerful Owls occur primarily in densely vegetated gullies of open and tall open forest, but they are also found in a wider range of habitats, including forests and woodlands within the metropolitan regions of cities (Cooke et al., 2002). However, optimal habitat requires large tracts of forest or woodland habitat, including a tall shrub layer and abundant hollows supporting high densities of arboreal marsupial prey species (DECC, 2006a).

This species roosts in dense mid-canopy trees (such as Turpentines, She-oaks and rainforest trees), or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines (DECC, 2006a). Nesting occurs in large hollows (greater than 45 cm wide and greater than 100 cm deep) in eucalypts in “unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines” (DECC, 2006a). Nest trees are typically emergent, and are often the largest and oldest in a stand (Debus and Chafer, 1994). Powerful Owls are faithful to traditional nesting hollows but can also use other hollows within the nesting gully.

Pairs of birds occupy large home ranges (300-1500 ha; DECC, 2006a), utilising various portions of this area at different times, depending on the local abundance of arboreal mammals as a food source (Debus and Chafer, 1994). Powerful Owls prey predominantly on arboreal mammals, particularly the Greater Glider and Ringtail Possum. The relative importance of prey items appears to vary regionally, with other prey such as Sugar Gliders, Brushtail Possums, Grey-headed Flying Foxes, insects and birds also used (Debus and Chafer, 1994; DECC, 2006a).

The level of understanding of the breeding biology and habitat use by Powerful Owls has not been defined in terms of a "viable local population" of the species. However, studies to date have shown that Powerful Owls can breed within urban areas, but the "degree of urbanization that the Powerful Owl can tolerate is still unknown" (Cooke, et al., 2002). Studies suggest that breeding is reduced in response to increased levels of urban activity. For instance one pair did not return to a nest site once a timber boardwalk was constructed under the nest tree (Cooke et al., 2002).

Similarly, habitat fragments less than 200 ha are generally not large enough to provide significant habitat for Powerful Owls in south-eastern NSW.

This species is threatened by a number of processes including loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development, which also affects the populations of arboreal prey species (DECC, 2005). Other threats include loss of hollow-bearing trees suitable for nesting, disturbance around nest sites (particularly during pre-laying, laying and downy chick stages), high frequency hazard reduction burning (affecting prey availability), secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats (DECC, 2005).

The Powerful Owl was not recorded during the field survey. The desktop survey revealed 11 previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in heavily timbered habitats in the Black Camp Creek area. The large hollow-bearing trees identified in the study area represent potential nesting sites.

(a) Factors likely to disrupt the life cycle of the Powerful Owl in the locality would include a substantial loss and / or fragmentation of foraging habitat and loss of suitable nesting and roosting habitat. The proposed development would result in the removal of a small amount (15 to 35 ha depending on the construction method) of potential foraging habitat and hollow trees with low potential for roosting and nesting. These areas do not provide optimal foraging, roosting or breeding habitat for the Powerful Owl, particularly when considering the available forest and woodland habitat in the surrounding ranges and forests, where more mature trees with hollows suitable for nesting, dense roosting vegetation and favoured prey species occur. The action will not place a viable local population of this species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of a small amount of habitat (15 to 35 ha depending on construction methods) in narrow strips. The species' home ranges are usually comprised of large areas of contiguous forest. The small amount of habitat that would be affected is already fragmented and does not represent suitable habitat for the breeding Powerful Owls. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like the Powerful Owl. (iii) The habitat loss would be minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Powerful Owl.

(f) A recovery plan for the Powerful Owl was produced by the Department of Environment and Conservation (DEC, 2006) with the following objectives or actions: 1. Model and map owl habitat and validate with surveys; 2. Monitor owl population parameters; 3. Audit forestry prescriptions; 4. Manage and protect habitat off reserves and state forests; 5. Undertake research; 6. Increase community awareness and involvement in owl conservation; and 7. Provide organisational support and integration. The proposed development may reduce a small area of potential foraging and nesting habitat which is inconsistent with objective 4. This objective expands to state that "impacts on large forest owls and their habitats should be adequately assessed during the environmental assessment process, and that significant owl habitat should be managed and protected". The significance of the area of habitat to be removed is being assessed pursuant to both state and national legislation (TSC Act, 1995; EPBC Act, 1999). This habitat is already degraded and this species would not be reliant on the habitat for survival, particularly when considering the large areas of preferable undisturbed habitat available in the adjacent ranges and forests where there are higher densities of prey species and hollow-bearing trees. Consequently, the removal of a small area of potential habitat adjacent to the current road is unlikely to result in a significant impact on the Powerful Owl in the study area.

(g) Key threatening processes of relevance to the Powerful Owl include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of a small amount of native vegetation and possibly some hollow-bearing tress. However, this habitat is not in large contiguous tracts of forest and is not considered to be important habitat for Powerful Owl. There are large amounts of more suitable habitat in the surrounding ranges and forests.

Mitigation measures

To minimise potential impacts to the Powerful Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats. This is most relevant in forest at the southern end of Black Camp Road.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without specific clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearance surveys should be conducted to assess hollow-bearing trees in the construction footprint for potential nests.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.

Masked Owl (*Tyto novaehollandiae*): Vulnerable

The Masked Owl is listed as Vulnerable under the TSC Act. The species distribution extends from the coast where it is most abundant to the western plains (DECC, 2005). Overall the records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner, and there is no seasonal variation in its distribution (DEC, 2005).

They occur in undulating wet-dry forests of the coast and dry eucalypt forests of the tablelands, with optimal habitat including a mosaic of sparse (grassy) and dense (shrubby) groundcover on gentle terrain (Kavanagh et al., 1995, Kavanagh, 1997). Roosts are located in live or occasionally dead hollow eucalypts, dense foliage in gullies and caves and recesses in cliffs (DECC, 2006a). They require mature forest or woodland with large hollow trees and dense trees or shrubs for fledglings to shelter in. Hollows greater than 40 cm wide and 100 cm deep in trees at least 90 cm DBH are used. Masked Owls are faithful to traditional nest trees but may use alternative hollows within the breeding territory in different years (DECC, 2006a). Home ranges are estimated to be 400-1000 ha, varying with habitat productivity (DECC, 2006a).

It is a specialist predator of terrestrial mammals, including rodents and rabbits in disturbed areas and dasyurids in forested areas (DECC, 2006a). Arboreal mammals (e.g. Sugar Glider), birds and bandicoots also supplement the diet. The species forages preferentially in ecotones within forests or along forest edges but also in open areas, and usually hunts from a perch at or near ground level, sometimes near the edges of roads (DECC, 2006a).

The Masked Owl is threatened by a number of processes including habitat clearing and fragmentation, loss of mature hollow-bearing trees, predation on fledglings, secondary poisoning from pesticides, disease, and being hit by vehicles (DECC, 2005). A combination of grazing and regular burning is also a threat, affecting the quality of ground cover for mammal prey, particularly in open, grassy forests (DECC, 2005).

The Masked Owl was not recorded during the field surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in heavily timbered habitats in the Black Camp Creek area. The large hollow-bearing trees identified in the study area represent potential nesting sites.

(a) Factors likely to disrupt the life cycle of the Masked Owl in the locality would include a substantial loss and / or fragmentation of foraging habitat and loss of suitable nesting and roosting habitat. The proposed development would result in the removal of a small amount (15 to 35 ha depending on the construction method) of potential foraging habitat and hollow trees with low potential for roosting and nesting. These areas do not provide optimal foraging, roosting or breeding habitat for the Masked Owl, particularly when considering the available forest and woodland habitat in the surrounding ranges and forests, where more mature trees with hollows suitable for nesting, dense roosting vegetation and favoured prey species occur. The action will not place a viable local population of this species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of a small amount of potential foraging and nesting habitat. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like the Masked Owl. (iii) The habitat loss would be minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival, particularly when considering a pair of Masked Owls will occupy a home range of approximately 400 to 1,000 ha (DECC, 2006a).

(e) No critical habitat has been declared by the Director-General of the NPWS for the Masked Owl.

(f) A recovery plan for the Masked Owl was produced by the Department of Environment and Conservation (DECC, 2006a) with the following objectives or actions: 1. Model and map owl habitat and validate with surveys; 2. Monitor owl population parameters; 3. Audit forestry prescriptions; 4. Manage and protect habitat off reserves and state forests; 5. Undertake research; 6. Increase community awareness and involvement in owl conservation; and 7. Provide organisational support and integration. The proposed development may reduce a small area of potential foraging and nesting habitat which is inconsistent with objective 4. This objective expands to state that “impacts on large forest owls and their habitats should be adequately assessed during the environmental assessment process, and that significant owl habitat should be managed and protected”. The significance of the area of habitat to be removed is being assessed pursuant to both state and national legislation (TSC Act, 1995; EPBC Act, 1999). The area of habitat being removed is already degraded and this species would not be reliant on the habitat for survival, particularly when considering the large areas of preferable undisturbed habitat available in the surrounding ranges and forests where higher densities of prey species and hollow-bearing trees occur. Consequently, the removal of a small area of potential habitat adjacent is unlikely to result in a significant impact on the Masked Owl in the study area.

(g) Key threatening processes of relevance to the Masked Owl include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and possibly the loss of some bearing tress. This would result in a small loss of habitat marginal for the species. Masked Owl is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests.

Mitigation measures

To minimise potential impacts to the Masked Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats. This is most relevant in forest at the southern end of Black Camp Road.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without specific clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearance surveys should be conducted to assess hollow-bearing trees in the construction footprint for potential nests.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.

Sooty Owl (*Tyto tenebricosa*): Vulnerable

The Sooty Owl is listed as Vulnerable under Schedule 2 of the TSC Act. It occurs primarily in densely vegetated east and southeast facing mountain gullies of open and tall wet forest (Kavanagh and Peake, 1993) and rainforests of the escarpment and coastal areas (DECC, 2006a). This species is strongly associated with sheltered gullies, especially where there is a tall, dense understorey (DECC, 2006a; DECC, 2005). There is no seasonal variation in its distribution (DEC, 2005). It is widespread throughout its range but within the limits imposed by the distribution of its specialised habitat (DEC, 2005). Its range has been reduced or fragmented by forest clearing for agriculture and urban developments and by reductions in habitat quality (DECC, 2005). Sooty Owl home ranges are estimated to be from 200 to 800 ha, according to habitat productivity (DECC, 2006a). This species is a generalist predator of arboreal, scansorial and small terrestrial mammals such as the Ringtail Possum, Sugar Glider, Bush Rat and Brown Antechinus. Nesting and roosting occur in dense unlogged corridors in gully systems. Sooty Owls roost during the day in sheltered, dense vegetation (such as sub-canopy rainforest trees), in tree hollows or caves, cliff ledges and rock overhangs (DEC, 2006a; DEC, 2005). Nest sites are usually hollows in living old eucalypt or rainforest species within 100 m of streams, but can be in caves (DECC, 2006a; DECC, 2005). Hollows are in trees of at least 120 cm diameter at breast height, and are greater than 40 cm wide and 100 cm deep. Owls are faithful to traditional nesting hollows.

This species is threatened by a number of processes including loss of mature hollow-bearing trees, changes to forest and woodland structure, clearing of habitat for grazing, agriculture, forestry or other development and secondary poisoning from rodenticides (DECC, 2005). A combination of grazing and regular burning is also a threat, through the effects on the quality of ground cover for mammal prey, particularly in open grassy forests (DECC, 2005).

The Sooty Owl was not recorded during the surveys. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in heavily timbered habitats in the Black Camp Creek area.

(a) The proposed development would not result in an adverse effect on the life cycle of the Sooty Owl since this species is expected to be restricted to old growth gully habitats in the locality. The small area of clearing of timbered habitats in the pipeline footprint will not impact on the Sooty Owl, since the species would be unlikely to utilise the area for foraging or nesting.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha of potential food trees and nesting habitat. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat clearance (15 to 35 ha, depending on construction methods) is not important for the Sooty Owl, since the species will only occur in the wider locality within deep old-growth gullies outside the proposed construction areas.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Sooty Owl.

(f) A recovery plan for the Sooty Owl was produced by the Department of Environment and Conservation (DECC, 2006a) with the following objectives or actions:

1. Model and map owl habitat and validate with surveys; 2. Monitor owl population parameters; 3. Audit forestry prescriptions; 4. Manage and protect habitat off reserves and state forests; 5. Undertake research; 6. Increase community awareness and involvement in owl conservation; and 7. Provide organisational support and integration. The proposed development is consistent with all objectives or actions of the recovery plan. There would be no impact from the proposed development on primary Sooty Owl habitat (sheltered gullies), which is consistent with objective 4.

(g) Key threatening processes of relevance to the Sooty Owl include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of a small amount native vegetation and possibly the loss of some hollow-bearing tress. However, this vegetation will not be removed from large contiguous blocks of old-growth forests or deep sheltered gullies, which are favoured habitats for the Sooty Owl. On this basis, the proposed action will not increase the impact of a key threatening process.

Mitigation measures

To minimise potential impacts to the Sooty Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats. This is most relevant in forest at the southern end of Black Camp Road.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without specific clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearance surveys should be conducted to assess hollow-bearing trees in the construction footprint for potential nests.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.

Spotted-tailed Quoll (*Dasyurus maculatus*): Vulnerable

The Spotted-tailed Quoll is listed as a Vulnerable species under the TSC Act and Endangered under the EPBC Act. It occupies a range of environments within a disjunct distribution along the east coast of Australia, extending from south-eastern Queensland through NSW and Victoria to Tasmania. This species is found in a variety of habitats, including sclerophyll forest and woodlands, coastal heatAECOMnds and rainforests (Dickman and Read, 1992; Edgar and Belcher, 1995). Occasional sightings are made in open country, grazing lands, rocky outcrops and other treeless areas.

Prey items include gliders and possums, small wallabies, rats, birds, bandicoots, rabbits, insects and carrion. Although mainly terrestrial, the Spotted-tailed Quoll is an agile climber and may raid possum and glider dens and prey on roosting and fledgling birds. Nesting occurs in rock shelters, hollow logs, caves or tree hollows and they use numerous dens within the home range. Estimates of home ranges vary from 800 ha to 20 km^2 and individuals may move several kilometres in a night (Edgar and Belcher, 1995). Breeding occurs from April to July with an average litter size of five (Edgar and Belcher, 1995).

The Spotted-tailed Quoll is threatened by a number of processes including loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development, logging and frequent fire (Edgar and Belcher, 1995; Dickman and Read, 1992). The loss of large hollow logs and other potential den sites (Scotts, 1992) is a major problem, as well as competition for food and predation by foxes and cats (Edgar and Belcher, 1995; Dickman and Read, 1992). Cats may also spread parasitic protozoan epidemics to Quolls (Edgar and Belcher, 1995; Dickman and Read, 1992). Persecution by humans is still an issue, because humans perceive Quolls as a predator on stock and poultry (Edgar and Belcher, 1995; Dickman and Read, 1992). Baiting of dingoes may also result in direct poisoning of Spotted-tailed Quolls and changes the composition of predators: reduced dingo numbers favours foxes which compete with quolls (Edgar and Belcher, 1995; Dickman and Read, 1992).

The Spotted-tailed Quoll was not recorded during the surveys. Thirty-nine previous records from within 5 km of the project site were revealed by the desktop survey. Potential foraging and breeding habitat was recorded in the study area along the Karuah River and in forested habitats at Black Camp Road and Wallaroo National Park.

(a) The proposed development would result in the removal of a small amount of timbered habitat and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. Riparian forests on the upper Karuah River and eucalypt forests at Black Camp Road and Wallaroo National Park may constitute habitat for this species. Clearance and fragmentation of riparian vegetation should be avoided. Habitat clearance elsewhere would have less impact because it is not preferred habitat compared to the large undisturbed areas of potential habitat available in the surrounding forests and ranges, which probably support a higher density of prey species and den sites. If clearance of riparian vegetation on the Karuah River is minimised, the action would be unlikely to place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha of timbered habitats. Riparian forests on the upper Karuah River and eucalypt forests at Black Camp Road and Wallaroo National Park may constitute habitat for this species. (ii) The habitat would only be removed in narrow strips from areas already fragmented. This would not cause any further fragmentation or isolation, except if riparian vegetation is cleared alongside the Karuah River. (iii) The proposed loss of timbered habitat is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival, except potentially beside the Karuah River where vegetation should not be cleared.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Spotted- tailed Quoll.

(f) There is currently no recovery plan or threat abatement plan for the Spotted-tailed Quoll. There are 32 priority action statements to help this species recover (DECC, 2005). Provided that vegetation clearance is kept to a minimum (especially riparian vegetation in the upper reaches of the Karuah River) the proposed development would not be inconsistent with any of the priority action statements.

(g) Key threatening processes of relevance to the Spotted-tailed Quoll include the clearing of native vegetation, removal of dead wood/trees, and high frequency fires (DECC, 2005). The proposed development would result in the clearing of native vegetation (and possibly some dead wood), resulting in a small loss of potential foraging and breeding habitat. For the most part, this species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding forests and ranges, which would support a much larger number of prey species and den sites. A possible exception to this is the riparian forests of the upper Karuah River. The proposed development would not increase the frequency of fires in the area.

Mitigation measures

To minimise potential impacts to the Spotted-tailed Quoll from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without pre- clearance surveys undertaken for the presence of nesting Quolls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Avoid clearing, modification or damage to riparian vegetation along the Karuah River.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.

Brush-tailed Phascogale (*Phascogale tapoatafa)*: Vulnerable

The Brush-tailed Phascogale is listed as Vulnerable under the TSC Act. The Brush-tailed Phascogale has a patchy distribution around the coast of Australia, from near sea level up to 1500 m (Soderquist, 1995). Within NSW, the species appears to be most abundant in the north-east and south-east of the State, particularly within forest habitats on the Great Dividing Range (Dickman and Read, 1992; Ayers et al., 1996).

The preferred habitat of the Brush-tailed Phascogale is dry sclerophyll open forest, with a sparse ground over of herbs, grasses, scleromorphic shrubs or leaf litter (Soderquist, 1995). However, individuals may also inhabit heatAECOMnd, swamps, rainforest and wet sclerophyll forest (Dickman and McKechnie, 1985). The species occurs primarily where the annual rainfall exceeds 500mm (Traill and Coates, 1993).

The Brush-tailed Phascogale is an arboreal species foraging in the canopy for prey. The females inhabit territories of approximately 20 to 60 ha, while the males maintain territories of up to 100 ha (Soderquist, 1993). They nest and shelter in many different hollows over a short time with mating occurring between May and July.

The main threats to the Brush-tailed Phascogale include:

- loss and fragmentation of habitat through clearing for agriculture and urban development
- logging of hollow-bearing trees suitable for nesting
- inappropriate fire regimes leading to a reduction in foraging and shelter resources
- predation by foxes and cats
- competition for suitable nesting hollows with the introduced honeybee.

The Brush-tailed Phascogale was not recorded during the surveys. The desktop survey revealed 30 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in forested habitats at Black Camp Road and Wallaroo National Park.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Brush-tailed Phascogale.

(f) There are seven strategy actions that have been identified to help recover this species: 1. Undertake a targeted community education program that raises awareness about threats such as predation by cats; 2. Undertake fox and wild dog control at priority sites; 3. design and implement an ecological burn (Dinner Creek) including habitat requirements of the species in Demon Nature Reserve; 4. Develop and provide environmental assessment guidelines for Local Councils and other consent or determining authorities to enable adequate consideration of the potential impacts of activities or actions on phascogale; 5. Establish a long term monitoring program targeting at least 30 populations across the known range of Brush-tailed Phascogale. The program will incorporate sites used for experimental fox control (as per Fox TAP); 6. Monitor the effectiveness of forestry threatened species licence conditions and refine and negotiate changes if required; and 7. Undertake research into the impact of hazard reduction burn practices.

The proposed development may reduce a small area of potential foraging and breeding habitat which does not correlate directly with any of the strategy actions, but does represent one of the major threats to the species. However, the area of habitat being removed is at best marginal habitat for the species and phascogales would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests.

Nonetheless, it is important to retain as many potential hollow trees as possible during construction of the pipeline, and to mitigate any impacts by providing artificial hollows in areas adjacent to where they were removed.

(g) Key threatening processes of relevance to the Brush-tailed Phascogale includes the clearing of native vegetation and the loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and a number of hollow-bearing trees, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Brush-tailed Phascogale from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road and Wallaroo National Park.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible;
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Common Planigale (*Planigale maculata)*: Vulnerable

The Common Planigale is listed as a Vulnerable Species on Schedule 2 of the TSC Act. The Common Planigale is distributed along coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its southern distribution limit on the NSW lower north coast (DECC, 2005).

The Common Planigale inhabits rainforest, eucalypt forest, heatAECOMnd, marsAECOMnd, grassland and rocky areas where there is surface cover, and usually in close proximity to water (Menkhorst et al., 2001). They forage on the ground looking for invertebrates and small vertebrates. Planigales are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks (Menkhorst et al., 2001).

The main threats to the Common Planigale include:

- predation by foxes and cats
- loss and fragmentation of habitat through clearing for agriculture and development in coastal areas
- frequent burning and grazing that reduces ground cover such as hollow logs and bark
- disturbance of vegetation surrounding water bodies (Menkhorst et al., 2001).

The Common Planigale was not recorded during the surveys. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and disturbance to ground habitat, which this species could potentially utilise for foraging and nesting. However, this area will be in narrow strips alongside previously cleared routes when alternative routes through disturbed land are not possible. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats and disturbance of ground cover. However, this area will be in narrow strips alongside previously cleared routes. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Common Planigale.

(f) There are eight strategy actions that have been identified to help recover this species. The main threat that the proposed development poses is the reduction of a small area of potential foraging and breeding habitat. However, the area of habitat being removed is at best marginal habitat for the species and planigales would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as much of the habitat as possible during construction of the pipeline, and to mitigate any impacts by providing artificial corridors of debris across the clearings and replacing the groundcover (leaf litter and logs) removed.

(g) Key threatening processes of relevance to the Common Planigale includes the clearing of native vegetation and ground cover (DECC, 2005). The proposed development would result in the clearing of native vegetation and ground cover, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Common Planigale from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Replace groundcover (e.g. leaf litter and logs) in forested habitats following construction. If required, provide artificial corridors of debris across cleared corridors.

Eastern Pygmy-possum (*Cercartetus nanus*): Vulnerable

The Eastern Pygmy-possum is listed as Vulnerable under the TSC Act. It is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania (DECC, 2005). In NSW, it ranges from the coast to inland as far as Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes (DECC, 2005). It is found mainly in woodlands and heath, but can also occupy rainforest and sclerophyll forest (DECC, 2005).

The Eastern Pygmy-Possum is a small (24 g) possum that feeds on insects and the pollen and nectar of Banksia, Eucalypt and Bottlebrush flowers (Turner and Ward, 1995). Soft fruits may be eaten when flowers are unavailable, and it is an important pollinator of heatAECOMnd plants (DECC, 2005). It shelter during the day in small tree hollows, holes in the ground, spherical nests under the bark of eucalypts, empty birds' nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation (DECC, 2005). These habitat requirements mean that suitable shelter sites are located in the same plant communities as the possums' food trees (Turner and Ward, 1995; Bowen and Goldingay, 2000). Young can be born whenever food sources are available, with most births occurring between late spring and early autumn (DEC, 2005). Winter is spent in suitable shelter sites in torpor (DECC, 2005).

The Eastern Pygmy-Possum is threatened by a number of processes including loss and fragmentation of habitat through land-clearing for agriculture, forestry and urban development, changed fire regimes that affect the abundance of flowering myrtaceous shrubs (particularly banksias), declining shrub diversity in forests and woodlands due to overgrazing by stock and rabbits, predation from cats, dogs and foxes, and loss of nest sites due to removal of firewood (DECC, 2005).

The Eastern Pygmy-Possum was not recorded during the surveys; but it is typically a difficult species to detect and targeted surveys appropriate for the species were not conducted. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable

(c) Not applicable

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Eastern Pygmy Possum

(f) There is currently no recovery plan or threat abatement plan for the Eastern Pygmy Possum (DECC, 2005). The action proposed is not inconsistent with the seven priority action statements designed to help this species recover (DECC, 2005).

(g) The Eastern Pygmy Possum is threatened by a number of key threatening processes, including clearing of native vegetation, and predation by feral cats and the European Red Fox (DECC, 2005).The area of vegetation proposed for clearance is minimal when considering the larger areas of more suitable habitat available in the surrounding forests and ranges. Furthermore, the removal of this vegetation will not increase the susceptibility of this species to predation by feral cats or the European Red Fox in the study area.

Mitigation measures

To minimise potential impacts to the Eastern Pygmy Possum from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without pre-clearance surveys undertaken for the presence of nesting possums.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Yellow-bellied Glider (*Petaurus australis)*: Vulnerable

The Yellow-bellied Glider is listed as Vulnerable under the TSC Act. It is widespread in south-eastern Australia but is found at low population densities in habitat that is patchily distributed, and it is seldom locally abundant (Goldingay and Kavanagh, 1991). Preferred habitat comprises productive, tall open sclerophyll forests containing mature trees that provide shelter and nesting hollows, and a mixture of eucalypt species to provide year-round continuity of food resources (NPWS, 2003b). Plant and insect exudates, including nectar, sap, honeydew and manna, provide the bulk of the diet. The Yellow-bellied Glider also feeds on the pollen of winter-flowering eucalypts and on arthropods which are found under decorticating bark (Goldingay and Kavanagh, 1991). Foraging occurs at night across a wide range of canopy heights and the species is known to travel for over 2 km from dens for foraging purposes (Russell, 1995).

The importance of different food types in the Yellow-bellied Glider varies with location and season. However, sugar-rich phloem sap provides a primary energy source (Lindenmayer, 2002). A characteristic feeding behaviour of the species involves incising the bark of eucalypts to obtain the sap, with the incisions or ‘sap sites’ in the trunk of the tree often triangular or v-shaped (Mackowski, 1988). Sap use and sap tree selection appears to be a complex behaviour (NPWS, 2003b). More than 30 tree species are used as sap trees throughout the Yellow-bellied Glider’s range (Lindenmayer, 2002), including Grey Gum *Eucalyptus propinqua* and *E. punctata*, Forest Red Gum *E. tereticornis*, Tallowwood *E. microcorys*, Red Mahogany *E. resinifera*, Messmate *E. obliqua* and Red Bloodwood *Corymbia gummifera* (NPWS, 1999b). However, at any one location, sap tree use is restricted to a small number of individual trees of several particular species (NPWS, 2003b). Suitable sap trees may account for less than one percent of all trees in a given stand and the same trees are often used repeatedly year after year (Lindenmayer, 2002). Given that trees with suitable sap flows needed by the Yellow-bellied Glider may be uncommon, the species is likely to maintain a large home range to encompass sufficient resources for a family group of animals (NPWS, 2003b). In addition to providing critical food resources for the Yellow- bellied Glider, sap trees also provide important focal points for group social exchange (Russell, 1984).

Food availability and the importance of different food types at any given location are strongly linked to climatic factors and the phenological pattern of tree species in a forest (NPWS, 2003b). Consequently, flowering or bark decortication events can lead to seasonal patterns of foraging behaviour, resource exploitation and use of tree species (NPWS, 2003b).

Small family groups consist of three to eleven individuals (Lindenmayer, 2002), usually with two or more adults and one or more offspring (Goldingay and Kavanagh, 1991). These family groups occupy home ranges of between 20 ha and 85 ha (Goldingay and Kavanagh, 1991) that are virtually exclusive and have little overlap with adjacent home ranges (NPWS, 2003). Such a large home range is thought to be required to ensure that a continuity of dispersed and variable food resources remains available throughout the year (Goldingay and Kavanagh, 1991; NPWS, 2003b).

The Yellow-bellied Glider uses particular areas of its home range when given tree species are flowering or shedding their bark. As the availability of food resources changes throughout the forest during the year, the gliders move to exploit key resources (Lindenmayer, 2002).

Yellow-bellied Gliders occupy tall, large diameter trees with large hollows (den trees). Family groups use up to 13 den trees within their home range (NPWS, 2003b). The reasons for den-swapping behaviour are not well understood (Lindenmayer, 2002). However it is likely to be related to maintaining proximity to food resources whose spatial location within an individual's home range varies on a seasonal basis.

Studies have shown that gliders are more likely to occur in forest stands that support a large number of tree hollows (Lindenmayer, 2002). Not all trees with hollows will be suitable for occupancy and sites that support more trees with hollows have a greater chance of containing some that can be used. Consequently, requirements for multiple den sites will be more likely met in areas that support numerous trees with hollows and loss of hollows from known habitat is likely to decrease the suitability of areas for the Yellow-bellied Gliders.

The Yellow-bellied Glider has low breeding potential with a single young usually produced each year (between May and September) but sometimes only in alternate years (NPWS, 2003b). After birth the young remain in the pouch for 100 days after which time it is left in the nest and suckled for up to 60 days (Russell, 1995). Animal longevity is a maximum of six years in the wild.

Habitat loss and fragmentation, primarily through land clearing, is one of the major factors threatening the long-term conservation of the Yellow-bellied Glider (Lindenmayer, 2002; NPWS, 2003b). Yellow-bellied Gliders are sensitive to habitat fragmentation through degradation of existing habitat, including loss of critical habitat elements, and creation of dispersal barriers which restricts the ability of the species to persist and to colonise new or isolated areas (NPWS, 2003b). The Yellow-bellied Glider may be particularly susceptible to habitat loss and fragmentation because it is wide-ranging, occurs at low densities and has a complex social system (Lindenmayer, 2002). In addition, the species is dependent on particular sap trees that can be sparse and widely distributed throughout the landscape. Their strong affinity to their home range also makes them highly susceptible to habitat loss, as they will not shift into adjoining areas even when most of their home range is destroyed, but remain in the disturbed area until they die or are taken by predators (Lindenmayer, 2002).

The main threats to the Yellow-bellied Glider include:

- loss and fragmentation of habitat
- loss of hollow-bearing trees
- loss of feed trees.

The Yellow-bellied Glider was not recorded during the surveys. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in large areas of timbered habitats at Black Camp Road and Wallaroo National Park. The presence of specific eucalypt species and hollow-bearing trees are important habitat requirements.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Yellow- bellied Glider.

(f) A recovery plan for the Yellow-bellied Glider was produced by the National Parks and Wildlife Service (NPWS, 2003b) with the following objectives or actions: 1. To co-ordinate the recovery of the Yellow-bellied Glider in NSW; 2. To encourage and assist in improving the protection and management of the Yellow-bellied Glider and its habitat; 3. To identify and monitor significant populations of the species; 4. To facilitate strategic research into the ecology of the Yellow-bellied Glider that is relevant to its conservation; and 5. To increase community awareness of the Yellow-bellied Glider and encourage community involvement in its conservation. The proposed development may reduce a small area of potential foraging and breeding habitat which is inconsistent with objective 2. However, the area of habitat being removed is at best marginal habitat for the species and Yellow-bellied Gliders would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Furthermore, the proposed works would not remove any known sap feed trees in the study area. Nonetheless, it is important to retain as many potential food trees and hollow trees as possible during construction of the pipeline, and to mitigate any impacts by providing artificial hollows in areas adjacent to where they were removed.

(g) Key threatening processes of relevance to the Yellow-bellied Glider includes the clearing of native vegetation and the loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and a number of hollow-bearing trees, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Yellow-bellied Glider from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Avoid the removal of hollow-bearing trees. No large hollow-bearing trees should be removed without specific pre-clearance surveys undertaken for the presence of den sites.
- Conduct pre-clearance surveys for feeding scars on eucalypt species that may be potentially used by gliders as sap feed trees.
- Recycle any hollows and logs that are removed and place them in adjacent areas of undisturbed vegetation.

Squirrel Glider (*Petaurus norfolcensis)*: Vulnerable

The Squirrel Glider is listed as Vulnerable on the TSC Act. The Squirrel Glider is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland (DECC, 2005).

The Squirrel Glider inhabits dry sclerophyll forest and woodland and is generally absent from rainforest and closed forest. In NSW, potential habitat includes Box-Ironbark forests and woodlands in the west, the River Red Gum forests of the Murray Valley and the eucalypt forests of the northeast. Individuals have also been recorded in a diverse range of vegetation communities, including Blackbutt, Forest Red Gum and Red Bloodwood forests, Coastal Banksia heatAECOMnd and Grey Gum / Spotted Gum / Grey Ironbark dry hardwood forests of the Central NSW Coast. The Squirrel Glider requires abundant hollow-bearing trees and a mix of eucalypts, acacias and banksias. Within a suitable vegetation community, at least one flora species should flower heavily in winter and one or more of the eucalypts should be smooth-barked.

This arboreal species have estimated home ranges of 0.65 to 8.55 ha, in which they forage for nectar, pollen, flowers acacia gum and insects. During winter, when other food resources are scarce, the Squirrel Glider may obtain its energy from the winter flowers of the Coastal Banksia, Red Ironbark, River Red Gum, Grey Ironbark, Spotted Gum, Forest Red Gum and, in some areas, Blackbutt. Grass trees and mature acacias may also provide a valuable food source. Smooth-barked eucalypts are preferred as these eucalypts form hollows more readily than rough-barked species and support a greater diversity of invertebrates.

The main threats to the Squirrel Glider include:

- loss and fragmentation of habitat
- loss of hollow-bearing trees
- loss of flowering understorey and midstorey shrubs in forests
- individuals can get caught in barbed wire fences while gliding.

The Squirrel Glider was not recorded during the surveys. The desktop survey revealed 18 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result.

(iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Squirrel Glider.

(f) There are nine strategy actions that have been identified to help recover this species: 1. Control feral horses at relevant sites to promote retention and growth of mid-storey shrubs; 2. Prepare EIA guidelines which address the retention of hollow-bearing trees maintaining diversity of age groups, species diversity. Give priority to largest hollow-bearing trees; 3. Ensure the largest hollow-bearing trees (including dead trees) are given highest priority for retention in PVP assessments and other environmental planning instruments, or other land assessment tools; 4. Investigate the effectiveness of logging prescriptions; 5. Prepare a recovery plan for the Squirrel Glider; 6. Conduct surveys and assessments of less known sites to confirm presence of species and negotiate, develop and implement conservation management agreements for high priority sites; 7. Delineate boundaries of population to identify the extent to which populations are interconnected (to determine propensity to move across cleared land); 8. Conduct surveys on the Far South Coast, from Murramarong National Park south to Eden, to determine population size and extent and connectivity of populations (surveys should incorporate potential habitat on public as well as private land); and 9. Model and predict the distribution of Squirrel Gliders across the south west slopes.

The proposed development may reduce a small area of potential foraging and breeding habitat which is inconsistent with objectives 2 and 3. However, the area of habitat being removed is at best marginal habitat for the species and Squirrel Gliders would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as many potential food trees and hollow-bearing trees as possible during construction of the pipeline, and to mitigate any impacts by providing artificial hollows in areas adjacent to where they were removed.

(g) Key threatening processes of relevance to the Squirrel Glider includes the clearing of native vegetation and the loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and a number of hollow-bearing trees, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Squirrel Glider from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Avoid the removal of hollow-bearing trees.
- Recycle any hollows and logs that are removed and place them in adjacent areas of undisturbed vegetation.

Koala (*Phascolarctos cinereus)*: Vulnerable

The Koala is listed as Vulnerable under the TSC Act. It has a fragmented distribution throughout eastern Australia (Martin and Handasyde, 1995). In NSW, the Koala mainly occurs on the central and north coasts (Reed and Lunney, 1990), although some populations occur in the western region.

Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species (Phillips, 1990). However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis (Hindell and Lee, 1990). In the Greater Taree area, Rough-barked Apple *Angophora subvelutina*, Spotted Gum *Corymbia maculata*, Broad-leaved White Mahogany *Eucalyptus carnea*, Tallowwood *Eucalyptus microcorys*, Grey Box *Eucalyptus moluccana*, Grey Gum *Eucalyptus propinqua*, Grey Gum *Eucalyptus punctata*, Grey Ironbark *Eucalyptus siderophloia*, Forest Redgum *Eucalyptus tereticornis*, Broad-leaved White Mahogany *Eucalyptus umbra*, Snow-in-Summer *Melaleuca linariifolia*, and Broad-leaved Paperbark *Melaleuca quinquenervia* (among others) are favoured by koalas (GTCCESP, 2007).

Although Koalas are often regarded as solitary, they actually live in complex groups and individual animals have overlapping home range areas (Martin and Handasyde, 1995). They favour individual trees within their home ranges which they visit often. Young eventually disperse and movements generally range from 1 to 11 km (Gall, 1980; Mitchell and Martin, 1990), but have been recorded in excess of 50 km.

The main threats to the Koala include:

- destruction of habitat by clearing for urban development, agriculture and mining, particularly on high nutrient content soils
- fragmentation of habitat by roads, urban development and agriculture, which creates barriers to movement, isolates individuals and populations, alters population dynamics and prevents gene flow and the ability to maintain recruitment levels
- mortality from attacks by dogs, road fatalities, fires, drought or other natural disasters, particularly in fragmented landscapes without suitable refuge areas
- degradation of habitat by fire, weed invasion, removal of important habitat trees and climate change
- in stressed populations, infection by CAECOMmydia, causing cystitis, keratoconjunctivitis, infertility and other symptoms.

The Koala was not recorded during the surveys. The desktop survey revealed 281 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha) depending on construction methods. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of favoured trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of preferred trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Squirrel Glider.

(f) There are 32 strategy actions that have been identified to help recover this species (DECC, 2005). The main threat by the proposed development is that it may reduce a small area of potential foraging habitat. However, the area of habitat being removed is at best marginal habitat for the species and koalas would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as many potential food trees as possible during construction of the pipeline.

(g) Key threatening processes of relevance to the koalas includes the clearing of native vegetation and preferred food trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and preferred food trees, resulting in a small loss of foraging habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Koala from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Pre-clearance surveys should include “Koala Spotters” working ahead of vegetation clearing activities. If Koalas are located, clearing activities should be halted temporarily until the animals relocate.

Parma Wallaby (*Macropus parma)*: Vulnerable

The Parma Wallaby is listed as Vulnerable under the TSC Act. Parma Wallabies once occurred from north-eastern NSW to the Bega area in the southeast but now it is confined to the coast and ranges of central and northern NSW. Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.

The main threats to the Parma Wallaby include:

- predation by feral cats and foxes
- loss and fragmentation of habitat through clearing
- removal of the understorey and shrub layer by grazing stock
- frequent burning of understorey reducing shrub layer, particularly at forest margins
- collisions with vehicles.

The Parma Wallaby was not recorded during the surveys. The desktop survey revealed three previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and disturbance to understorey habitat, which this species could potentially utilise for foraging and shelter. However, this area will be in narrow strips alongside previously cleared routes when alternative routes through disturbed land are not possible. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats and disturbance of understorey. However, this area will be in narrow strips alongside previously cleared routes. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Parma Wallaby.

(f) There are 11 strategy actions that have been identified to help recover this species and the main threat that the proposed development poses is the clearing of dense understorey of potential foraging and shelter habitat. However, the area of habitat being removed is at best marginal habitat for the species and Parma Wallaby would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as much of the habitat as possible during construction of the pipeline, and to mitigate any impacts by placing removed cover to areas that have been previously been cleared.

(g) Key threatening processes of relevance to the Parma Wallaby includes the clearing of native vegetation and understorey (DECC, 2005). The proposed development would result in the clearing of native vegetation and understorey, resulting in a small loss of foraging and sheltering habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Parma Wallaby from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.

Long-nosed Potoroo (*Potorous tridactylus*): Vulnerable

The Long-nosed Potoroo is listed as Vulnerable on the TSC Act and Vulnerable under the EPBC Act. They are found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm (DECC, 2005).

The Long-nosed Potoroo inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. Individuals are mainly solitary, foraging on the ground for fungi, tubers and invertebrates in 2-5 ha home ranges.

The main threats to the Long-nosed Potoroo include:

- habitat loss and fragmentation from land clearing for residential and agricultural development
- predation from foxes, dogs and cats
- too frequent fires or grazing by stock that reduce the density and floristic diversity of understorey vegetation
- logging regimes or other disturbances that reduce the availability and abundance food resources, particularly hypogeous fungi, and ground cover.

The Long-nosed Potoroo was not recorded during the surveys. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and disturbance to ground habitat, which this species could potentially utilise for foraging and nesting. However, this area will be in narrow strips alongside previously cleared routes when alternative routes through disturbed land are not possible. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats and disturbance of ground cover. However, this area will be in narrow strips alongside previously cleared routes. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Long-nosed Potoroo.

(f) There are 19 strategy actions that have been identified to help recover this species. The main threat that the proposed development poses is the clearing of dense understorey that provides potential foraging and breeding habitat. However, the area of habitat being removed is at best marginal habitat for the species and potoroos would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as much of the habitat as possible during construction of the pipeline, and to mitigate any impacts by placing removed cover to areas that have been previously been cleared.

(g) Key threatening processes of relevance to the Long-nosed Potoroo includes the clearing of native vegetation and ground cover (DECC, 2005). The proposed development would result in the clearing of native vegetation and ground cover, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Long-nosed Potoroo from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Grey-headed Flying-fox (*Pteropus poliocephalus)*: Vulnerable

The Grey-headed Flying-fox is listed as Vulnerable under Schedule 2 of the TSC Act and Vulnerable under the EPBC Act. The species is endemic to the east coast of Australia with a distribution from Bundaberg (Queensland) in the north to Melbourne (Victoria) in the south, from the western slopes of the Great Dividing Range to the coast (Eby, 2000). The distribution of this species has recently suffered a southward contraction and a 30% population decline over the last ten years (Tidemann et al., 1999).

Grey-headed Flying-foxes are a highly mobile species whose migration patterns are determined by the availability of flowering food resources (Eby, 1991). The species is a canopy-feeding frugivore, blossom-eater and nectarivore, and inhabits rainforest, woodlands, paperbark swamps and Banksia woodlands. This species feeds in particular on the nectar and pollen of native trees, especially *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. During times when native food resources are limited, Grey-headed Flying Foxes forage on fruit crops and cultivated gardens.

Grey-headed Flying-foxes congregate in large colonies of up to 200,000 individuals in the summer season (Churchill, 1998). Camp sites are generally located next to rivers or creeks, and occur in a range of vegetation communities including rainforest, wet sclerophyll forest, paperbark woodland, casuarina forest or mangroves (Eby, 2000). These sites have a dense canopy, providing them with the moist, humid microclimate they require. Campsites are critical for mating, birthing, rearing of young and as a diurnal refuge from predators (Tidemann et al., 1999). Urban gardens, cultivated fruit crops and roadside verges may also provide temporary roosting habitat for this species.

Grey-headed Flying-foxes breed annually commencing in January. Females give birth to a single young after a 6 month gestation and dependant neonates are carried by their mother during evening foraging flights for the first 3 weeks after birth. When the young can independently thermoregulate they remain in a 'crèche' at the camp while the adults forage (Eby, 1995).

The main threats to the Grey-headed Flying-fox include:

- unregulated shooting
- loss of foraging habitat
- disturbance of roosting sites
- electrocution on powerlines.

Grey-headed Flying-foxes were not recorded within the study area during the field surveys. The desktop survey revealed 12 previous records from within 5 km of the project site. All native timbered habitats in the study area can be considered potential foraging habitats, but no camp or roost sites were located in the proposed development footprint.

(a) The proposed development would remove a small area of potential foraging habitat (approximately 15 to 35 ha depending on construction methods) for the Grey-headed Flying Fox. It is unlikely that a viable local population of this species would be dependent upon this small area to be removed. The proposed development would not remove or disturb any known campsite or colony of the Grey-headed Flying-fox and would not create a barrier to movements between campsites and foraging areas for this highly and wide-ranging species. The proposed development is unlikely to disrupt the lifecycle of the Grey-headed Flying Fox such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest and it would not include any camp or roost sites. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat of relevance to the Grey-headed Flying-fox has been declared by the Director-General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Grey-headed Flying-fox (DECC, 2005). The proposed development is not inconsistent with the 31 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Grey-headed Flying-fox include the clearing of native vegetation (DECC, 2005), and in particular the clearing of critical winter foraging habitat. Shortages in food supply lead to the starvation of animals, self-abortion by pregnant females (Dukelow et al., 1990) and high infant mortality in summer. Whilst the proposed development would involve the clearing of approximately 15 to 35 ha of timbered habitats, this is unlikely to constitute a process that threatens, or may have the capability to threaten, the survival or evolutionary development of the Grey-headed Flying Fox, given:

- the relatively small area of potential foraging habitat for this species to be removed from the study area in comparison to the large areas of potential habitat in the surrounding forests and ranges
- the absence of any camp site on the study area or in the locality
- the proposed development would not create a barrier to the movements between campsites and foraging areas of this highly mobile and wide-ranging species.

Mitigation measures

To minimise potential impacts to the Grey-headed Flying-fox from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.

Large-eared Pied Bat (*Chalinolobus dwyeri)*: Vulnerable

The Large-eared Pied Bat is listed as Vulnerable under Schedule 2 of the TSC Act and Vulnerable under the EPBC Act. The species occupies a range of forested environments from dry sclerophyll forests and woodlands to rainforest and wet sclerophyll forest (Churchill, 1998). It mainly occurs in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern HigAECOMnds (DECC, 2005). It is generally rare in NSW, with only scattered records from the New England Tablelands and North West Slopes (DECC, 2005).

This species roosts communally during the day near the entrances of caves, crevices in cliffs, mines, tunnels, culverts, and disused mud nests of the Fairy Martin (*Hirundo ariel*) (DEC, 2005). Its flight pattern is relatively slow, direct and only moderately manoeuvrable. They forage predominantly below the canopy level and also low along creek beds (Hoye and Dwyer, 1995). Little is known about the preferred prey of this species, but they are insectivorous (Hoye and Dwyer, 1995).

It is uncertain whether mating occurs during early winter or in spring, but females have been recorded raising young in maternity roosts from November through to January, utilising roof domes in sandstone caves (DECC, 2005). They remain loyal to the same cave over many years and are likely to hibernate through the coolest months (DECC, 2005).

This species is threatened by a number of processes including clearing or isolation of forest and woodland foraging habitats near cliffs, caves and old mine workings, damage to roosting and maternity sites, and the use of pesticides (DECC, 2005).

The Large-eared Pied Bat was not recorded during the surveys. One previous record from within 5 km of the project site was revealed by the desktop survey. Potential foraging habitats were recorded in timbered habitats within the study area. Roosting and breeding habitats (i.e. caves) were not recorded in the project footprint.

(a) Whilst some tree-hollows in the study area may provide temporary roost sites for this species, they are not considered a primary or critical roosting resource for the Large-eared Pied Bat, as the species does not normally occur this far south. The proposed removal of a relatively small area of vegetation (15 to 35 ha) is not expected to significantly affect the lifecycle of this species, since it will not impact on any known maternity roosting caves. The proposed development will not impact on the accessibility of this species to any caves that exist in the study area, and will not result in the destruction of, or disturbance to, any primary roosting habitat. The proposed development is unlikely to disrupt the lifecycle of the Large-eared Pied Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the modification of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, the proposed development is south of the species usual range, and the development footprint does not contain any caves, which are the main breeding and roosting habitat. (ii) Potential foraging habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. In addition, the Large-eared Pied Bat is highly mobile and wide-ranging and is capable of travelling substantial distances in an evening of foraging, and is capable of utilising modified landscapes, roosting under bridges, in mines, and storm water drains (Schultz, 1998). (iii) Given the widespread distribution and high mobility of the Large-eared Pied Bat, it is highly unlikely that the proposed development would involve an area of habitat being modified or removed, particularly when considering the large areas of suitable habitat available in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat of relevance to the Large-eared Pied Bat has been declared by the Director-General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Large-eared Pied Bat. The proposed development is not inconsistent with the 17 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Large-eared Pied Bat include the clearing of native vegetation (DECC, 2005).The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, which may contain some hollow-bearing trees. This species is not expected to be reliant on this vegetation, particularly when considering the large areas of more suitable habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Large-eared Pied Bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis)*: Vulnerable

The Eastern False Pipistrelle is listed as Vulnerable under Schedule 2 of the TSC Act. The species is wide-ranging, occurring along the southeast coast of Australia with records from South East Queensland, New South Wales, Victoria and Tasmania.

Preferred habitat is usually sclerophyll forests from the Great Dividing Range to the coast, while in Tasmania they are found in wet sclerophyll and coastal mallee (Churchill, 1998). They generally prefer wet habitats where trees are more than 20 m high. Roosting occurs in hollow trunks of eucalypt trees, usually in single sex colonies, but have been recorded roosting in caves, under loose bark and occasionally in old wooden buildings (Churchill, 1998). Their flight pattern is high and fast, often with sudden darting changes in direction and they forage within or just below the tree canopy. On the mainland they feed on a variety of prey including moths, rove beetles, weevils, plant bugs, flies and ants. Females are pregnant in late spring to early summer, with single young being born in December (Churchill, 1998). Lactation continues through January and February (Churchill, 1998).

The main threats to this species include:

- loss of trees for foraging and hollow-bearing trees for roosting
- disturbance to winter roosting and breeding sites
- application of pesticides in or adjacent to foraging areas (DECC, 2005).

The Eastern False Pipistrelle was not recorded during the field surveys. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area. It could potentially occur within the study area due to the presence of suitable foraging habitat and potential roost sites (e.g. hollow-bearing trees, abandoned buildings).

(a) The proposed development would require the removal of 15 to 35 ha of timbered habitats (depending on construction methods) and possibly a number of hollow-bearing trees which could provide potential roosting and foraging habitat for the Eastern False Pipistrelle. It is also possible that some of the younger trees in the study area contain small hollows of suitable size for this species. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows. When considering the large areas of more suitable habitat in the surrounding forests and ranges, this species is unlikely to be reliant on the vegetation to be removed. Nearby habitats outside the footprint of the proposed development are less disturbed, and would contain higher densities of hollow-bearing trees. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Eastern False Pipistrelle such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The proposed development is unlikely to result in an area of known habitat becoming isolated from other habitat for the Eastern False Pipistrelle given that the stands of vegetation exist within an already fragmented landscape and the Eastern False Pipistrelle is a strong-flying bat which feeds predominantly above the canopy or in large openings (Phillips, 1995). The proposed development would not further isolate any area of foraging habitat for this wide-ranging and mobile species. (iii) The proposed development would require the removal of a relatively small area of potential habitat. This area could not be regarded as important habitat for the Eastern False Pipistrelle on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges.

(e) No critical habitat of relevance to the Eastern False Pipistrelle has been declared by the Director-General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Eastern False Pipistrelle. Sixteen priority action statements have been prepared to help recover this species (DECC, 2005). One of these states that attempts should be made to ensure the largest hollow-bearing trees, including dead trees and paddock trees are given highest priority for retention during land assessments. Provided the mitigation measures are followed, as identified below, then the proposed development would not be inconsistent with all sixteen priority action statements.

(g) Key threatening processes of relevance to the Eastern False Pipistrelle include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Eastern False Pipistrelle in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges.

Mitigation measures

To minimise potential impacts to the Eastern False Pipistrelle from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Little Bent-wing Bat (*Miniopterus australis)*: Vulnerable

The Little Bentwing-bat is listed as a Vulnerable species under Schedule 2 of the TSC Act. Little Bentwing-bats are small insectivorous bats with a body length of about 45 mm. They occur in coastal north-eastern NSW and eastern Queensland, where they favour moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW, the largest maternity colony is in close association with a large maternity colony of Common Bentwing-bats and appears to depend on the large colony to provide the high temperatures needed to rear its young.

The main threats to the Little Bent-wing Bat include:

- disturbance of colonies, especially in nursery or hibernating caves may be catastrophic
- destruction of caves that provide seasonal or potential roosting sites
- changes to habitat, especially surrounding maternity caves
- Application of pesticides in or adjacent to foraging areas.

The Little Bent-wing Bat was not recorded during the field surveys. The desktop survey revealed 14 previous records from within 5 km of the project site. Potential foraging habitats were recorded in timbered habitats within the study area. There is little preferred roosting habitat and no known breeding habitat in the project site. The southern-most known breeding habitat (maternity cave) is in the Macleay watershed, well north of the subject site.

(a) The proposed development would remove only a small area of potential foraging habitat for the Little Bent-wing Bat. Whilst some trees with hollows are likely to be removed, these features are only occasionally used by the Little Bent-wing Bat and do not constitute primary roosting habitat for this species. No nursery caves exist within the proposed footprint, and the proposed development would not disturb any caves that may be utilised in the study area. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Little Bent-wing Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential foraging habitat (approximately 15 to 35 ha, depending on construction methods). (ii) The stands of vegetation within the study area that provide potential habitat for the Little Bent-wing Bat exist within an already fragmented landscape and modified. Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Common Bent-wing Bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging. This area could not be regarded as important habitat for the Common Bent-wing Bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding ranges and forests. The proposed development would not impact on any known nursery caves critical for this species and is therefore not important to the long-term survival of this species.

(e) No critical habitat of relevance to the Little Bent-wing Bat has been declared by the Director- General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Little Bent-wing Bat. The proposed development is not inconsistent with the 25 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Little Bent-wing Bat include the clearing of native vegetation, predation by the European Red Fox, and predation by Feral Cats (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Little Bent-wing Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forest and ranges. The development is unlikely to increase the susceptibility of this species to predation by the European Red Fox or Feral Cats.

Mitigation measures

To minimise potential impacts to the Little Bent-wing Bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Common Bent-wing Bat (*Miniopterus schreibersii)*: Vulnerable

The Common Bent-wing Bat is listed as a Vulnerable species under Schedule 2 of the TSC Act. The species occupies a range of forested environments (including wet and dry sclerophyll forests), along the coastal portion of eastern Australia, and through the Northern Territory and Kimberley area (subject to subdivision of this species) (Churchill, 1998).

This species has a fast, level flight exhibiting swift shallow dives (Dwyer, 1995). It forages from just above the tree canopy to many times the canopy height in forested areas, and will utilise open areas where it is known to forage at lower levels. Moths appear to be the main dietary component (Churchill, 1998).

This highly mobile species is capable of large regional movements in relation to seasonal differences in reproductive behaviour and winter hibernation (Gilmore and Parnaby, 1994). It is reliant on large nursery caves for the rearing of its young, between October and February (Churchill, 1998), with substantial numbers of bats (up to 150,000 individuals) occupying a common nursery cave during the breeding season and often returning to the same site on an annual basis. Although roosting primarily occurs in caves, it has also been recorded in mines, culverts, stormwater channels, buildings, and occasionally tree-hollows (Churchill, 1998). It occupies a number of roosts within specific territorial ranges, usually within 300 km of the maternity cave (Churchill, 1998), and may travel large distances between roost sites (Dwyer, 1995).

The main threats to the Common Bent-wing Bat include:

- loss of foraging habitat
- damage to or disturbance of roosting caves (particularly during winter or breeding)
- application of pesticides in or adjacent to foraging areas
- predation by feral cats and foxes (DECC, 2005).

The Common Bent-wing Bat was not recorded during the field surveys. The desktop survey revealed 14 previous records from within 5 km of the project site. Potential foraging habitats were recorded in timbered habitats within the study area. It could potentially occur within the study area due to the presence of suitable foraging habitat, but there is little preferred roosting habitat and no known breeding habitat within the proposed development footprint.

(a) The proposed development would remove only a small area of potential foraging habitat for the Common Bent-wing Bat. Whilst some trees with hollows are likely to be removed, these features are only occasionally used by the Common Bent-wing Bat and do not constitute primary roosting habitat for this species. No nursery caves exist within the proposed footprint, and the proposed development would not disturb any caves that may be utilised in the study area. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Common Bent-wing Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential foraging habitat (approximately 15 to 35 ha, depending on construction methods). (ii) The stands of vegetation within the study area that provide potential habitat for the Common Bent-wing Bat exist within an already fragmented landscape and modified. Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Common Bent-wing Bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat. This area could not be regarded as important habitat for the Common Bent-wing Bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding ranges and forests. The proposed development would not impact on any known nursery caves critical for this species and is therefore not important to the long-term survival of this species.

(e) No critical habitat of relevance to the Common Bent-wing Bat has been declared by the Director-General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Common Bent-wing Bat. The proposed development is not inconsistent with the 25 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Common Bent-wing Bat include the clearing of native vegetation, predation by the European Red Fox, and predation by Feral Cats (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Common Bent-wing Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forest and ranges. The development is unlikely to increase the susceptibility of this species to predation by the European Red Fox or Feral Cats.

Mitigation measures

To minimise potential impacts to the Common Bent-wing Bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Eastern Free-tail Bat (*Mormopterus norfolkensis)*: Vulnerable

The Eastern Freetail-bat is listed as Vulnerable under Schedule 2 of the TSC Act. The Eastern Freetail-bat is found along the east coast from southern Queensland to southern NSW, and is very poorly understood. They occur in dry sclerophyll forest and woodland east of the Great Dividing Range. They roost mainly in tree hollows but will also roost under bark or in man-made structures. They are solitary and probably insectivorous.

The main threats to the Eastern Freetail-bat include:

- loss of hollow-bearing trees
- loss of foraging habitat
- application of pesticides in or adjacent to foraging areas.

The Eastern Freetail-bat was not recorded during the field surveys. The desktop survey revealed 10 previous records from within 5 km of the project site. Potential foraging and roosting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would require the removal of 15 to 35 ha of timbered habitats (depending on construction methods) and possibly a number of hollow-bearing trees which could provide potential roosting and foraging habitat for the Eastern Freetail-bat. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows. When considering the large areas of more suitable habitat in the surrounding forests and ranges, this species is unlikely to be reliant on the vegetation to be removed. Nearby habitats outside the footprint of the proposed development are less disturbed, and would contain higher densities of hollow-bearing trees. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Eastern Freetail-bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The proposed development is unlikely to result in an area of known habitat becoming isolated from other habitat for the Eastern Freetail-bat given that the stands of vegetation exist within an already fragmented landscape. The proposed development would not further isolate any area of foraging habitat for this mobile species. (iii) The proposed development would require the removal of a relatively small area of potential habitat. This area could not be regarded as important habitat for the Eastern Freetail-bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges.

(e) No critical habitat of relevance to the Eastern Freetail-bat has been declared by the Director- General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Eastern Freetail-bat. The proposed development is not inconsistent with the 18 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Eastern Freetail-bat include the clearing of native vegetation, predation by the European Red Fox, and predation by Feral Cats (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Eastern Freetail-bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forest and ranges. The development is unlikely to increase the susceptibility of this species to predation by the European Red Fox or Feral Cats.

Mitigation measures

To minimise potential impacts to the Eastern Freetail-bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Large-footed Myotis (*Myotis adversus)*: Vulnerable

The Large-footed Myotis (or Southern Myotis, *Myotis macropus*) is listed as Vulnerable under Schedule 2 of the TSC Act. This bat is considered to be widespread throughout the coastal regions of eastern and northern Australia, ranging from the Kimberley in Western Australia to Victoria and South Australia (Churchill, 1998). It is relatively common in tropical areas but uncommon further south (NPWS, 1994), and rare in Victoria (Menkhorst and Lumsden, 1995). Whilst regarded as having a primarily coastal distribution (rarely found more than 100 km inland), it does occur farther inland along major rivers (Churchill, 1998).

This species has been recorded in mangroves, paperbark swamps and in a range of forest and woodland habitats (Churchill, 1998). It is a cave dweller, but is also known to roost in tree hollows, under bridges, in clumps of vegetation, buildings, mine tunnels and stormwater drains (Menkhorst et al., 2001; Churchill, 1998). Roosts are usually in groups of 10-15, in close proximity to water over which the bats forage. The large feet and hind claws are used to rake the water surface for insects and small fish, and Large-footed Myotis is known to forage in small groups of three or four (Churchill, 1998). This species is also capable of foraging aerially (Menkhorst et al., 2001). In NSW, females have one young each year, usually in November or December (DECC, 2005).

The main threats to this species include:

- loss or disturbance of roosting sites
- clearing adjacent to foraging areas
- application of pesticides in or adjacent to foraging areas
- reduction in stream water quality affecting food resources (DECC, 2005).

The Large-footed Myotis was not recorded during the field surveys. The desktop survey revealed 10 previous records from within 5 km of the project site. Potential foraging, roosting and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would remove only a relatively small area of potential foraging and roosting habitat for the Large-footed Myotis. Whilst some trees with hollows would possibly be removed, the species is not expected to be reliant on these for survival, especially when considering the higher densities of hollow-bearing trees that would exist in the surrounding areas of ranges and forests. These areas may also exist closer to larger water sources such as major rivers, swamps and dams, which is the preferred location for roost sites for this species. If riparian vegetation (e.g. along the Karuah River) is protected, then the proposed development is unlikely to disrupt the lifecycle of the Large-footed Myotis such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The stands of vegetation within the study area that provide potential habitat for the Large-footed Myotis exist within an already fragmented landscape and highly modified. Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Large-footed Myotis. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat.

This area could not be regarded as important habitat for the Large-footed Myotis on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges. Roost sites for the Large-footed Myotis generally occur close to large waterbodies in which they forage, such as major rives and swamps. Provided that riparian habitats (e.g. along the Karuah River) are protected, no impacts should occur to potential roosting habitat for this species.

(e) No critical habitat of relevance to the Large-footed Myotis has been declared by the Director-General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Large-footed Myotis. The proposed development would not be inconsistent with the 15 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Large-footed Myotis include the clearing of native vegetation, loss of hollow-bearing trees, and the alteration to natural flow regimes (DECC, 2005). The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Large-footed Myotis in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges. The pipeline would cross several permanent streams. However, if HDD is used and riparian vegetation is protected there will be no impact on habitat of the Large-footed Myotis.

Mitigation measures

To minimise potential impacts to the Large-footed Myotis from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain riparian vegetation along the Karuah River.
- Use HDD techniques on all crossings of permanent streams to avoid impacts to riparian vegetation and flow regimes.

Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris)*: Vulnerable

The Yellow-bellied Sheathtail-Bat) is listed as a Vulnerable species under Schedule 2 of the TSC Act. Endemic to Australia, it is a wide-ranging species occurring throughout tropical Australia with many records extending into south-eastern Australia (Churchill, 1998). It is a rare late summer-autumn visitor to southern Australia (Menkhorst et al., 2001) with most records reported between January and June (Churchill, 1998).

The Yellow-bellied Sheathtail-Bat is found in a variety of habitats from wet and dry sclerophyll forests to open woodland, Acacia scrubland, mallee, grasslands and deserts. It roosts singly or in roosts of up to six, in tree-hollows and buildings, abandoned nests of Sugar Gliders and occasionally hanging from the outside walls of buildings in broad daylight (Churchill, 1998). In treeless areas it is known to utilise mammal burrows (DECC, 2005). Its flight pattern is high and fast and it forages above the canopy, which is probably why this species is rarely captured in traps and nets. Foraging occurs is most habitats across its very wide range, both with and without trees (DECC, 2005), and it feeds on a variety of prey including grasshoppers, bugs, flying ants, and beetles, which comprise approximately 90% of its diet (Churchill, 1998). Breeding has been recorded from December to mid-March, when a single young is born (DECC, 2005).

The main threats to the Yellow-bellied Sheathtail-Bat include:

- disturbance to roosting and summer breeding sites
- foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions
- loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat
- pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores.

The Yellow-bellied Sheathtail-Bat was not recorded during the surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging, roosting and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would remove only a relatively small area of potential foraging and roosting habitat for the Yellow-bellied Sheathtail-Bat. The proposed development would possibly require the removal of a small number of large hollow-bearing trees, which could provide potential roosting and foraging habitat for the Yellow-bellied Sheathtail-bat. It is also possible that some of the younger trees in the study area contain small hollows of suitable size for this species. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows. When considering the large areas of more suitable habitat in the surrounding forest and ranges, this species is unlikely to be reliant on the vegetation to be removed. Surrounding habitat that is less disturbed would contain higher densities of hollow-bearing trees. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Yellow-bellied Sheathtail-Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The stands of vegetation within the study area that provide potential habitat for the Yellow- bellied Sheathtail-bat exist within an already fragmented landscape and highly modified; Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Yellow-bellied Sheathtail-bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat. This area could not be regarded as important habitat for the Yellow-bellied Sheathtail-bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges.

(e) No critical habitat of relevance to the Yellow-bellied Sheathtail-bat has been declared by the Director-General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Yellow-bellied Sheathtailbat. Twenty priority action statements have been prepared to help recover this species (DECC, 2005). One of these states attempts should be made to ensure the largest hollow-bearing trees, including dead trees and paddock trees are given highest priority for retention during land assessments. Provided mitigation measures are followed, the proposed development would not be inconsistent with all twenty one priority action statements.

(g) Key threatening processes of relevance to the Yellow-bellied Sheathtail-bat include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees.

This is likely to only result in a small reduction in the available foraging and roosting resources for the Yellow-bellied Sheathtail-Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges.

Mitigation measures

To minimise potential impacts to the Yellow-bellied Sheathtail-bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of vegetation to cleared by reducing the width of the footprint in timbered habitats.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Greater Broad-nosed Bat (*Scoteanax rueppellii)*: Vulnerable

The Greater Broad-nosed Bat is listed as Vulnerable under Schedule 2 of the TSC Act. The species occurs along the east coast of Australia inhabiting moist gullies and river systems from the Atherton Tableland in QLD to southern NSW. The distributional stronghold of the Greater Broad-nosed Bat is in the gullies and river systems draining the Great Dividing Range (Hoye and Richards, 1995).

The Greater Broad-nosed Bat is found in a variety of habitats from dry woodland to tall, wet forests and does not occur at altitudes above 500 m (Hoye and Richards, 1995), except in the very north of its range where it has been recorded at 780 m (Churchill, 1998). This species roosts in tree-hollows, tree branches and in the roofs of old buildings. Its flight pattern is suited to open eucalypt woodlands and forests particularly because it has limited manoeuvrability and is a noticeably slow flier. It feeds on slow flying prey (such as large moths), but will also feed on ground beetles. These are 'hawked' within 20 m of the ground along rows of trees which line creeks and small rivers, and the edges of patches of woodland in otherwise cleared paddocks (Churchill, 1998). The Greater Broad-nosed Bat is also known to eat other small bats, including the threatened Little Bent-wing Bat, especially when captured together in harp traps or mist nets.

. The main threats to the Greater Broad-nosed Bat include:

- land clearing (resulting in the loss of foraging habitat
- loss of hollow-bearing trees
- disturbance to roosting and summer breeding sites
- pesticide and herbicide use (reducing the availability of insects and / or resulting in the accumulation of toxic residues in individuals' fat stores)
- changes to water regimes impacting on food resources.

The Greater Broad-nosed Bat was not recorded during the surveys. The desktop survey revealed seven previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas of the study area. It could potentially occur within the study area due to the presence of suitable foraging habitat and potential roost sites (e.g. hollow-bearing trees).

(a) The proposed development would possibly require the removal of a small number of large hollow-bearing trees, which could provide potential roosting and foraging habitat for the Greater Broad-nosed Bat. It is also possible that some of the younger trees in the study area contain small hollows of suitable size for this species. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows.

When considering the large areas of more suitable habitat in the surrounding forest and ranges, this species is unlikely to be reliant on the vegetation to be removed. Surrounding habitat that is less disturbed would contain higher densities of hollow-bearing trees. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Greater Broad-nosed Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The stands of vegetation within the study area that provide potential habitat for the Greater Broad-nosed Bat exist within an already fragmented landscape and highly modified; Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Greater Broad-nosed Bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat. This area could not be regarded as important habitat for the Greater Broad-nosed Bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges.

(e) No critical habitat of relevance to the Greater Broad-nosed Bat has been declared by the Director-General of the NPWS.

(f) There is currently no recovery plan or threat abatement plan for the Greater Broad-nosed Bat. Nineteen priority action statements have been prepared to help recover this species (DECC, 2005). One of these states that attempts should be made to ensure the largest hollow-bearing trees, including dead trees and paddock trees are given highest priority for retention during land assessments. Provided the mitigation measures are followed, as identified below, then the proposed action would not be inconsistent with all 19 priority action statements.

(g) Key threatening processes of relevance to the Greater Broad-nosed Bat include the clearing of native vegetation, and the loss of hollow-bearing trees (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Greater Broad-nosed Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges.

Mitigation measures

To minimise potential impacts to the Greater Broad-nosed Bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of vegetation to be cleared by reducing the width of the footprint in timbered habitats.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

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AECOM

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Gloucester Coal Seam Gas Project
Gloucester to Hexham
Amended Sections

Addendum

Ecological Assessment Report

October 2009

Alison Hunt and Associates Pty Ltd

TERRESTRIAL | MARINE | AQUATIC

Executive Summary

Alison Hunt & Associates Pty Ltd was commissioned by AECOM on behalf of AGL Gloucester L E Pty Ltd (AGL) to prepare an Addendum to the Ecological Assessment Report undertaken by ENSR Australia Pty Ltd (now known as AECOM) 2008 for sections of the Gloucester Coal Seam Gas Project which have not previously been assessed, and for several previously assessed areas requiring clarification. AGL proposes to develop the coal seam methane resources in the Gloucester Basin under *Petroleum Exploration Licence (PEL) No. 285* which was granted in 1992 under the *Petroleum (Onshore) Act 1991.* The proposal comprises a Stage 1 GFDA consisting of 110 wells, gas gathering lines, CPF, (including gas and water treatment and compression) at Stratford, and a gas transmission pipeline (pipeline) from the GFDA near Gloucester to Hexham, in the Hunter Region of NSW. AECOM is currently preparing an Environmental Assessment under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Key ecological issues that required clarification included the potential for endangered ecological communities, threatened species and / or their habitat listed under the TSC Act to occur within the study area, the potential for endangered ecological communities, threatened species and / or their habitat listed under the FM Act to occur within the study area, the potential presence of any matters of National Environmental Significance (NES) listed under the EPBC Act and any avoidance, management or mitigation options.

This report has been prepared as an addendum to, and should be read in conjunction with:

> AECOM 2009 *Gloucester Coal Seam Gas Project. Ecological Assessment. Gloucester to Hexham.* Report prepared for AGL, Gloucester NSW.

The project footprint areas which have been amended since the original ecological assessment undertaken by AECOM (2009) are the subject of this addendum report and include:

- Expansion of the Stage 1 Gas Field Development Area (GFD) encompassing approximately 20 additional well site locations (total of 110) within the red boundary of the figure provided by AECOM (Ref. 11/05/09 Ref: 1980);
- Amended pipeline alignment totalling approximately 26 km between the following Kilometre Points (KPs) (note that these KPs relate to the Rev E version of the pipeline):
    - KP 17 – 25 – route realigned between these KPs to avoid a number of horizontal directional drilling (HDD) crossings of the river;
    - KP 27.5 - Ramstation Creek crossing;
    - KP 71 – 82.8 – route realigned; and
    - KP 89.5 – 95 – route realigned.

There are also several areas previously assessed which required clarification and these were:

- Clarifications at the following KPs (KPs relate to Rev C):
    - Approximately KP 68 – identified as *Freshwater Wetland on Coastal Floodplains*. Horizontal directional drilling (HDD) initially recommended but this is not feasible from a constructability perspective. Will need to be reassessed for potential impacts.
    - Approximately KP 68 – 69.5 – identified as *Swamp Sclerophyll Forest of Coastal Floodplains*. It was recommended that clearing be reduced by restricting the route to existing powerline easement. However, this is not practical from constructability perspective; and
    - Approximately KP 49.5 – ecologists recommended creek crossing of a tributary of Bridge Creek by HDD. However, this is not feasible from a constructability perspective and requires reassessment.

This assessment was undertaken after the amendment of the project footprint, to describe the biodiversity values of previously unassessed areas and areas requiring clarification. This was undertaken in order to determine the likely potential impacts associated with the proposal within the framework provided by Part 3A under the EP&A Act, TSC Act, FM Act and Commonwealth EPBC Act and with reference to the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007) and *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines: Matters of National Environmental Significance* (DEH 2006).

Several tasks were addressed including a review of available literature and databases to assist with the identification of site values especially in relation to threatened species, populations and endangered ecological communities, field investigations undertaken 8 June 2009 to 12 June 2009, to ascertain the current site condition and the presence or likely presence of threatened or protected species, an impact assessment to determine the likely effects of the proposal on the terrestrial and aquatic ecology of the site with particular reference to threatened species, populations and / or ecological communities and preparation of preliminary recommendations to ameliorate and mitigate any impacts. Field assessments included habitat descriptions, records of dominant flora, mapping of vegetation communities, fauna habitat assessments and assessments as to the likely occurrence of threatened species, populations and communities. Due to time constraints this assessment was largely based on predictive modelling using habitat assessment. Consequently this assessment was aimed at providing an overall assessment of the ecological values of the amended areas of the GFDA and pipeline route with particular emphasis on the likely occurrence of threatened species. In line with the central tenet of the precautionary principle it was assumed that if habitat was present for a threatened species then it was considered that the threatened species could potentially occur and assessments were made accordingly.

The amended sections of the proposed pipeline total approximately 26 km of which approximately 5.5 km contain remnant or regrowth vegetation. The majority of the native vegetation along the proposed pipeline route falls within the *Hunter-Macleay Dry Sclerophyll Forests* vegetation class which are transitional between the *Dry Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests* of the steeper and wetter slopes (Keith 2004). The canopy vegetation is largely dominated by Spotted Gum (*Corymbia maculata*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Grey Box (*E. moluccana*), Grey Gum (*E. punctata*), Small-fruited Grey Gum (*E. propinqua*) and Grey Ironbark (*E. siderophloia*). Shrubs are characterised by Silver-stemmed Wattle (*Acacia parvipinnula*), Forest Oak (*Allocasuarina torulosa*), Coffee Bush (*Breynia oblongifolia*), Gorse Bitter Pea (*Daviesia ulicifolia*) and Peach Heath (*Lissanthe strigosa*). White Root (*Pratia purpurascens*), Mulga Fern

(*Cheilanthes sieberi subsp. sieberi*), Barbed Wire Grass (*Cymbopogon refractus*), Kangaroo Grass (*Themeda australis*) and Wiry Panic (*Entolasia stricta*) dominate the understorey. These areas grade into the mostly cleared, lower elevation areas of higher rainfall along the lower sections of the proposed pipeline. These areas become more saline-influenced closer to the Hunter River floodplain. Clearing for the amended pipeline route would include 1.51 ha of Spotted Gum Ironbark Forest, 2.24 ha of Grey – Stringybark – Bloodwood Forest, 0.23 ha of Hunter Lowland Redgum Forest (EEC) and 0.08 ha of riparian vegetation at Ramstation Creek. The southern end of the amended pipeline route would be horizontally directionally drilled under the Hunter River and SEPP 14 wetlands at Tomago and consequently no clearing of these sensitive areas is anticipated. These areas form part of the Hunter Estuary National Park and these areas are known to support significant flora, fauna and communities.

Predictive modelling indicates that 13 flora, 29 fauna and 18 migratory / marine species listed under the EPBC Act have the potential to occur within the locality of the GFDA and amended areas of the proposed pipeline route. The amended sections of the proposed pipeline and GFDA would provide potential habitat for 10 flora, 13 fauna and 18 migratory species which are listed under the EPBC Act. None of the listed species were recorded within the assessed areas of amended route although several sections of the GFDA and amended pipeline have habitat which could potentially provide a number of threatened flora with suitable habitat, and fauna with roosting and foraging habitat.

Thirty five EECs listed under the TSC Act are known, or are predicted, to occur within the Hunter CMA sub-region. The only EEC which would be directly impacted by this proposal is *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions*. Approximately 250 m of the amended pipeline route passes *Hunter Lowland Redgum Forest* at KP 76.3 and runs adjacent to another patch of this EEC at KP 75.7. It is estimated that 0.23 ha would be removed as a consequence of construction of the pipeline. There have been 19 flora and 69 fauna species listed under the TSC Act recorded within the locality (i.e. 5 km buffer). Those species with the potential to occur along the amended sections of the pipeline and GFDA include 12 flora and 43 fauna species. None of the flora and only one of the fauna species was recorded during this study although habitat occurs for many of these species. The Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) which is listed as vulnerable under the TSC Act was recorded (Figure 2) within a wooded area adjacent to the gathering lines of the proposed south-eastern most well in the GFDA, and it is likely that this species would occur along the access tracks and adjacent woodlands of several of the other well sites.

In general, the proposed pipeline route has been located so as to avoid areas of high biodiversity which would be most likely to provide habitat to listed species and endangered ecological communities. In unavoidable areas of high conservation status, (e.g. SEPP 14 Wetlands, Hunter River Estuary, substantial riparian areas), HDD techniques would be undertaken to avoid direct impacts on these areas and potential impacts could be managed and mitigated with stringent environmental management. Therefore, it was concluded that with the implementation of stringent mitigation measures and environmental management, that the Stage 1 GFDA extension and the amended sections of the pipeline route would be unlikely to significantly impact any species, population or habitat listed under the TSC Act, FM Act and EPBC Act.

To ensure protection of ecological values, mitigation measures should be aimed at minimising impacts on site values and protection of biodiversity values across the locality. The recommendations and mitigation measures detailed in AECOM (2009) should also be implemented in the Stage 1 GFDA

extension and along the sections of amended pipeline route. Particular attention should be focussed on avoiding direct and indirect impacts to the *Hunter Lowland Redgum Forest* and indirect impacts to occurrences of *Swamp Oak Floodplain Forest* which occur adjacent to the amended pipeline route. Of particular importance will be the need to minimise changes to natural flow regimes of rivers, streams, floodplains and wetlands as much of the southern section of the amended pipeline route traverses low lying water-logged areas. Central to these measures should be the preparation and implementation of a CEMP and OEMP.

GLOSSARY OF TERMS

Glossary & Acronyms	
AGL	AGL Gloucester L E Pty Ltd
Bioregion	A territory defined by a combination of biological, social and geographical criteria rather than by geopolitical considerations; generally, a system of related, interconnected ecosystems.
CEMP	Construction Environmental Management Plan
CKPoM	Comprehensive Koala Plan of Management
cm	Centimetres
CPF	Central Processing Facilities
CRA	Comprehensive Regional Assessment
DEC	Department of Environment and Conservation (NSW Government Department succeeded by the DECC)
DECC	Department of Environment and Climate Change (NSW Government Department).
DEH	Department of the Environment and Heritage (Commonwealth Government Department succeeded by the DEWHA)
DEWHA	Department of Environment, Water, Heritage and the Arts
E	Endangered
Ecological community	An assemblage of different species occupying a particular area.
Edge effects	The changes in the environmental conditions of a patch of habitat that result from an edge or boundary in the environment.
EEC	Endangered ecological community
Endangered species	Used in reference to a species, population or ecological community, specified in the *Threatened Species Conservation Act 1995*, *Fisheries Management Act 1994* or *Environment Protection and Biodiversity Conservation Act 1999* that is in danger of becoming extinct if threats continue, or its numbers are reduced to a critical level, or its habitat is reduced.
Environment	The aggregate of all conditions that influence the life of a species, including natural, social, cultural, built and spatial elements.
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act*

	1999.
ES	Ecosystem - vegetation mapping units
ESD	Environmentally Sustainable Development
Exotic species	A species occurring in an area outside its historically known natural range as a result of intentional or accidental dispersal by human.
Floodplain	The flat area usually toward the lower end of a river system where periodic flooding has deposited river-borne materials.
Flora	The entire plant life of a site or region.
FM Act	NSW *Fisheries Management Act 1994*
Fragmentation	The division of natural areas by vegetation clearance for human land use, isolating the remnants and the species within them and limiting genetic flow.
GCB	Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
GFDA	Stage 1 GFDA extension
GGBF	Green and Golden Bell Frog (*Litoria aurea*)
GHFF	Grey-headed Flying-fox (*Pteropus poliocephalus*)
HBT	Hollow-bearing tree
HDD	horizontal directional drilling
hectare (ha)	10,000 square metres
Km	Kilometre
KP	Kilometre Point
KTP	Key threatening processes
L/s	Litres per second
LGA	Local Government Area
LHCC	Lower Hunter and the Central Coast
LHCCREMS	Lower Hunter and the Central Coast Regional Environment Management Strategy
m	Metres
M	Migratory
Mar	Marine
mm	Millimetres
Native	Species that are native to (i.e. occur naturally) in a region.

Native vegetation	Any local indigenous plant community containing throughout its growth the complement of native species and habitats normally associated with that vegetation type or having the potential to develop these characteristics. It includes vegetation with these characteristics that has been regenerated with human assistance following disturbance. It excludes plantations and vegetation that has been established for commercial purposes.
NES	National Environmental Significance
Noxious	Undesirable, troublesome, difficult to control or eradicate.
NPWS	NSW national Parks and Wildlife Service
NW Act	*Noxious Weeds Act 1993*
OEMP	Operational Environmental Management Plan
PAS	Priority Action Statements
PEL	*Petroleum Exploration Licence No 285*
Pipeline	Gas Transmission Pipeline from Central Processing Facilities in Gloucester to Hexham.
Population	A group of individuals of the same species, forming a breeding unit and sharing a habitat.
Preservation	Maintaining the physical material of places or objects in their existing state and retarding deterioration.
Regrowth	Native vegetation containing a substantial proportion of individuals that are in the younger growth phase and are actively growing in height and diameter.
Remnant vegetation	A small fragmented portion of the former dominant vegetation which once covered the area before being cleared.
Riparian	Situated on or within a riverbank.
RoTAP	Rare or Threatened Australian Plants
ROW	Right of Way
Saltmarsh	Saltwater wetland occupied mainly by herbs and dwarf shrubs, characteristically able to tolerate extremes of environmental conditions, notably waterlogging and salinity.
SECP	Sediment and Erosion Control Plan
SEPP 14 Wetlands	*State Environmental Planning Policy 14 - Coastal Wetlands.* State legislation that aims to ensure that coastal wetlands are preserved and protected in the environmental and economic interests of the State.
Species	A group of organisms that is biologically capable of breeding and producing fertile offspring with each other but not with members of other species.

Species diversity	A measure of the number of individuals and their relative abundance in an area.
Threatened	Refers to a species, population or ecological community specified in the *Threatened Species Conservation Act 1995, Fisheries Management Act 1994* or *Environment Protection and Biodiversity Conservation Act 1999* that is either endangered, vulnerable, or presumed extinct.
TSC Act	NSW *Threatened Species Conservation Act 1995*.
V	Vulnerable
Waterlogging	The saturation of soils with water; often associated with insufficient oxygen for good plant growth.
Weed	Any plant that is not cultivated deliberately by humans but that grows entirely or predominantly in situations disturbed by humans.

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1 INTRODUCTION

1.1 Background

Alison Hunt & Associates Pty Ltd was commissioned by AECOM on behalf of AGL Gloucester L E Pty Ltd (AGL) to prepare an Addendum to the Ecological Assessment Report undertaken by ENSR Australia Pty Ltd (now known as AECOM) 2008 for sections of the Gloucester Coal Seam Gas Project which have not previously been assessed, and for several previously assessed areas requiring clarification.

AECOM is currently preparing an Environmental Assessment in accordance with requirements of Condition No. 1 (Environmental Assessment) of *Petroleum Exploration Licence (PEL) No. 285.* An application under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) resulted in the issuance of Director-General's requirements for environmental assessment. A referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to the Department of Environment, Water, Heritage and the Arts (DEWHA) resulted in the proposal being deemed a controlled action. Consequently, this assessment was considered within the framework under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Key ecological issues that required clarification included:

- The potential for endangered ecological communities (EECs), threatened species and / or their habitat listed under the TSC Act to occur within the study area;
- The potential for endangered ecological communities, threatened species and / or their habitat listed under the FM Act to occur within the study area;
- The potential presence of any matters of National Environmental Significance (NES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- Any avoidance, management or mitigation options.

This report has been prepared as an addendum to, and should be read in conjunction with:

> AECOM 2009 *Gloucester Coal Seam Gas Project. Ecological Assessment. Gloucester to Hexham.* Report prepared for AGL, Gloucester NSW.

There are several areas of the project footprint that have been amended since the original ecological assessment undertaken by AECOM (2009). These are:

- Expansion of the Stage 1 Gas Field Development Area (GFD) encompassing approximately 20 additional well site locations (total of 110) within the red boundary of the figure provided by AECOM (Ref. 11/05/09 Ref: 1980);

- Amended pipeline alignment totalling approximately 26 km between the following Kilometre Points (KPs) (note that these KPs relate to the Rev E version of the pipeline):
    - KP 17 – 25 – route realigned between these KPs to avoid a number of horizontal directional drilling (HDD) crossings of the river;
    - KP 27.5 - Ramstation Creek crossing;
    - KP 71 – 82.8 – route realigned; and
    - KP 89.5 – 95 – route realigned.

There are also several areas previously assessed which require clarification and these are:

- Clarifications at the following KPs (KPs relate to Rev C):
    - Approximately KP 68 – identified as *Freshwater Wetland on Coastal Floodplains*. Horizontal directional drilling (HDD) initially recommended but this is not feasible from a constructability perspective. Will need to be reassessed for potential impacts.
    - Approximately KP 68 – 69.5 – identified as *Swamp Sclerophyll Forest of Coastal Floodplains*. It was recommended that clearing be reduced by restricting the route to existing powerline easement. However, this is not practical from constructability perspective; and
    - Approximately KP 49.5 – ecologists recommended creek crossing of a tributary of Bridge Creek by HDD. However, this is not feasible from a constructability perspective and requires reassessment.

1.2 Project Location

The study area (overall project area), is located to the north of Newcastle, from Gloucester to Hexham, NSW (**Figure 1**) and falls within six local government areas (LGAs), including Gloucester, Dungog, Great Lakes, Port Stephens, Maitland and Newcastle. The study area is located with the Hunter – Central Rivers Catchment Management Authority and includes three main catchments (the Avon, Karuah and Williams / Hunter) and the proposed pipeline route crosses numerous waterways (AECOM 2009). Broadly, the locations of the components of the project are:

- Stage 1 Gas Field Development Area (GFDA) is located east of Gloucester and Stratford and covers an area of approximately 50.33 km^2;
- Central Processing Facilities (CPF) is proposed to be located adjacent to an existing rail loop near the south-east corner of the GFDA; and
- Gas Transmission Pipeline (pipeline) from the CPF to Hexham and would be approximately 95km long.

Only the expanded Stage 1 GFDA extension and amended sections of the pipeline route have been addressed in this assessment, being those aspects of the project that have been amended.

1.3 Brief Project Description

AGL proposes to develop the coal seam methane resources in the Gloucester Basin under *Petroleum Exploration Licence (PEL) No. 285* which was granted in 1992 under the *Petroleum (Onshore) Act 1991.* The proposal comprises a Stage 1 GFDA consisting of 110 wells, gas gathering lines, CPF, (including gas and water treatment and compression) at Stratford, and a gas transmission pipeline (pipeline) from the GFDA near Gloucester to Hexham, in the Hunter Region of NSW.

1.3.1 Gas Field Development Area and Central Processing Facilities

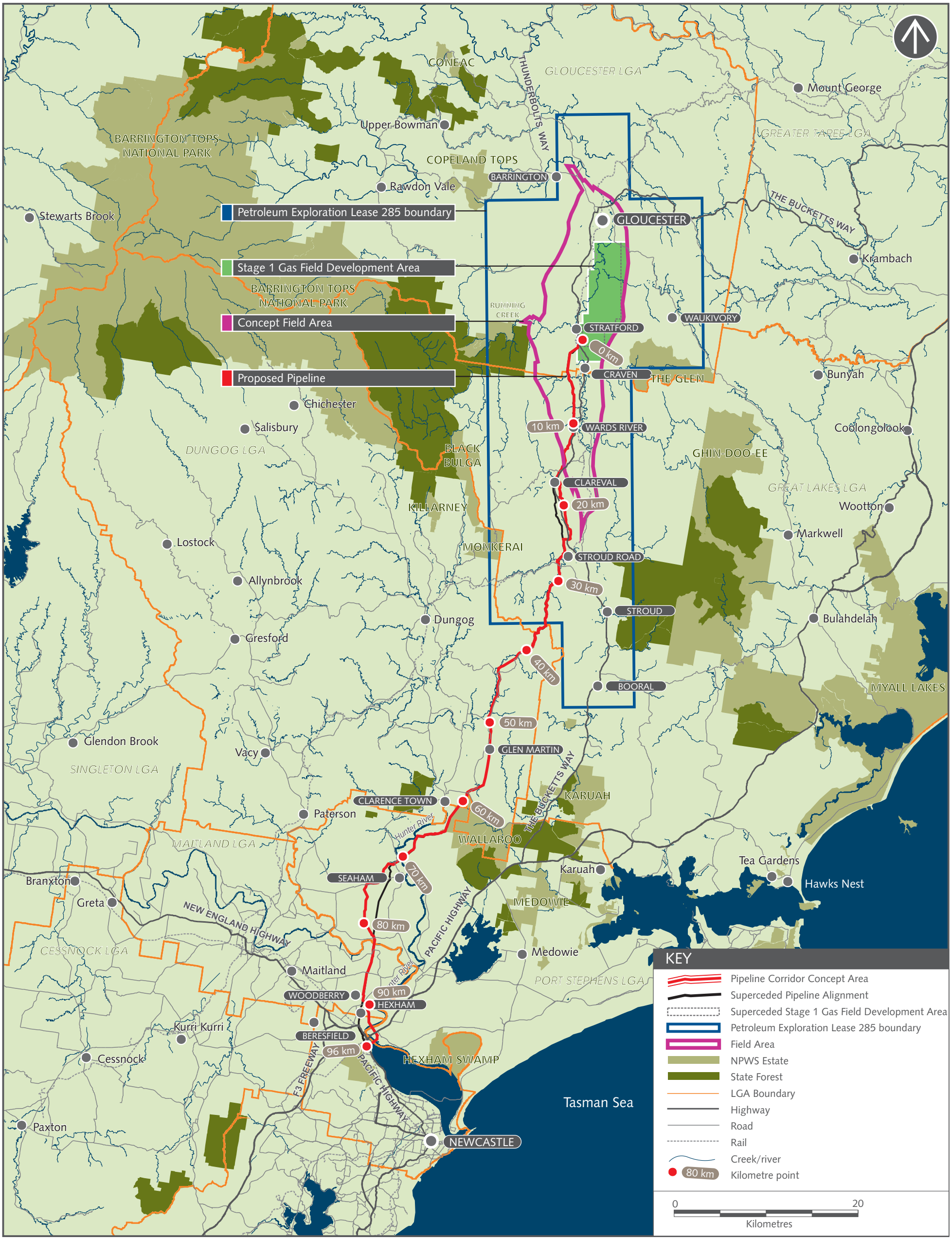
The proposed GFDA is currently comprised of lands used for agriculture and mining. Agricultural practices include grazing and cropping with a number of homesteads located throughout. Stratford Colliery open cut mine is located at the southern end of the GFDA. The proposed location of the CPF is adjacent to an existing rail loop near the south-east corner of the GFDA. The infrastructure would consist of a network of up to 110 wells and associated gas gathering lines. The arrangement of the wells has been loosely identified within the GFDA but detailed locations are to be designed and finalised around the environmental and social constraints identified during the environmental approval process. Gas gathering lines would transport the gas from the individual wellheads into a main trunkline, which would be connected to the CPF. The gas would then be transported to Hexham via an underground pipeline.

1.3.2 Pipeline

The entire proposed gas transmission pipeline would be approximately 95km long, running from the CPF near Gloucester to Hexham. It would pass primarily through cleared agricultural land, but would transect a number of remnant vegetation patches, rivers, creeks and other drainage lines. The proposed pipeline would be underground. In already cleared areas without other constraints, the disturbance footprint would be contained within a 30 m right of way (ROW). In sensitive areas (e.g. remnant native vegetation, stream crossings, on steep slopes), the ROW would be reduced to minimise impacts.

1.4 Legislative Framework

A number of legislative requirements in relation to the biodiversity of the site would be relevant to the proposal and these are detailed in AECOM (2009).



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GLOUCESTER COAL SEAM METHANE GAS PROJECT LOCATION AND PEL 285 BOUNDARY

FIGURE 1

2 METHODS

This assessment was undertaken after the amendment of the project footprint, to describe the biodiversity values of previously unassessed areas and areas requiring clarification in order to determine the likely potential impacts associated with the proposal within the framework provided by Part 3A under the EP&A Act, TSC Act, FM Act and Commonwealth EPBC Act and with reference to the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007) and *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines: Matters of National Environmental Significance* (DEH 2006).

Several tasks were undertaken including:

- A review of available literature and databases to assist with the identification of site values especially in relation to threatened species, populations and endangered ecological communities;
- Field investigations to ascertain the current site condition and the presence or likely presence of threatened or protected species;
- An impact assessment to determine the likely effects of the proposal on the terrestrial and aquatic ecology of the site with particular reference to threatened species, populations and / or ecological communities; and
- Preparation of preliminary recommendations to ameliorate and mitigate any impacts.

2.1 Literature Review

Available literature and database records pertaining to the site and locality (i.e. within a 5 km buffer of the proposed pipeline) were reviewed. The full list of reference materials is provided in Section 7 and those of particular relevance are listed below:

- AECOM 2009 Gloucester Coal Seam Gas Project. Ecological Assessment. Gloucester to Hexham. Report prepared for AGL Gloucester LE Pty Ltd, Gloucester NSW.
- GHD 2008 Report on Gloucester Coal Seam Gas Project. Land and Approvals – Task 4. Prepared for Lucas Energy.
- Department of Environment and Climate Change (DECC 2008a) – Threatened species database records (accessed by AECOM 14 August 2008);
- Department of Environment, Water, Heritage and the Arts (DEWHA) – Online protected matters search tool for matters of National Environmental Significance (NES) (accessed by AECOM 14 August 2008).

2.2 Site Assessments

Assessments of the study area were undertaken to determine the current values of the ecology of the Stage 1 GFDA extension and a 100 m wide assessment area associated with the amended sections of pipeline and other areas requiring clarification. Of particular focus was determining the presence, or likely presence of threatened flora or fauna, and the likely potential impacts of construction and operation.

Assessments were undertaken from 8 June 2009 to 12 June 2009. The assessment schedule was brief and not all areas could be walked. However,

- Where possible the assessment areas were traversed by:
    1. foot in areas of intact vegetation or where no vehicular access was available; or
    2. vehicle along areas of clearly disturbed habitat.
- Assessment areas that fell within private landholdings, where permission to access had not been provided, were assessed from the fence line of adjoining properties; and
- Aerial photograph interpretation was also relied upon in some areas.

2.2.1 General Habitat Description

Habitat descriptions were recorded within the GFDA and amended pipeline route. Details recorded included vegetation type (including dominant canopy, shrub and ground cover species), soil type, topography, potential habitat for threatened species (e.g. presence of hollow-bearing trees, waterbodies, nests, fallen logs, rocks); and indirect evidence of species (e.g. diggings, scratches, feed scars, burrows, nests).

2.2.2 Vegetation Assessment

General

The key areas within the Stage 1 GFDA extension were assessed by driving and walking to areas previously identified by aerial photograph interpretation as being in close proximity to remnant vegetation or near drainage lines and farm dams, whilst the amended pipeline route was traversed in areas with remnant vegetation and the dominant flora species were recorded. The majority of the amended portions of the route traversed areas of disturbed agricultural lands devoid of any substantial vegetation. The assessment of flora in these areas consisted of noting the dominant flora species and the degree of disturbance. In areas of intact vegetation more detailed notes were taken to ascertain the species present. Specimens unidentifiable in the field were retained for later identification.

Vegetation Mapping

Previous vegetation mapping for the area was reviewed and included the mapping prepared by:

- Lower Hunter and Central Coast (LHCC) Region vegetation mapping, which covers the southern section of the proposed pipeline from KP 60 to KP 91.6 (NPWS 2000);
- Forest ecosystem Classification and Mapping of the Upper and Lower North East Comprehensive Regional Assessment (CRA) regions (NPWS 1999); and
- The Native Vegetation of New South Wales and the ACT (Keith 2004).

Only small sections of the amended pipeline route and GFDA had been assigned vegetation classification under these mapping systems. Where mapping existed the mapping was ground-verified during the surveys and further details on the dominant species within each community recorded. Where the amended pipeline route traversed unmapped native vegetation detailed records were taken and the communities mapped.

Endangered Ecological Communities (EECs)

Of particular focus was the potential presence of any endangered ecological communities listed under the TSC Act and EPBC Act. A list of species for each of the remnant vegetation patches was compared to characteristic species listed in the Scientific Committee Final Determinations for each of the EECs with the potential to occur within the locality. Other key characteristics such as elevation, soil type and hydrological requirements listed in the Final Determination for the EEC were also used in determining its presence or absence. This was particularly relevant to areas previously assessed which required clarification as these remnants were considered to represent EECs (refer to Section 3.6).

Threatened or Significant Flora

The likelihood of threatened species listed under the TSC Act and / or EPBC Act occurring within the GFDA and amended pipeline route was determined through consideration of vegetation type and condition, and the occurrence of habitat across the locality and review of literature and database records. Targeted surveys for threatened species were not undertaken. Instead data collected during the habitat surveys were used as a predictor of the likelihood of occurrence of these species given the habitat resources, vegetation community, terrain, soil type, level of connectivity and level of disturbance. Consideration was also given to detecting the presence of regionally significant species and those species listed as Rare or Threatened Australian Plants (RoTAP). Regionally significant flora are those which are uncommon, have narrow habitat requirements, are restricted to the local government areas or are close to the limit of their distribution in the area. In line with the central tenet of the precautionary principle it was assumed that if habitat was present for a threatened species then it was considered that the threatened species could potentially occur and assessments were undertaken accordingly.

2.2.3 Fauna

General

Habitat assessments were used to assess the likelihood of the presence of fauna and comprised an assessment of the nature and condition of habitats, specific resources and features of relevance for native fauna. In addition, indirect evidence of fauna (e.g. scats, feathers, fur, tracks, dens, nests, scratches, chew marks and owl wash) was recorded. Incidental records of fauna were also made during the course of the pipeline assessment.

Threatened or Significant Fauna

The likelihood of threatened species listed under the TSC Act and / or EPBC Act occurring across the assessed areas of the pipeline route was determined through consideration of vegetation type and condition, the occurrence of suitable habitat across the locality and its condition, and review of literature and database records. In line with the central tenet of the precautionary principle it was assumed that if habitat was present for a threatened species then it was considered that the threatened species could potentially use this resource and assessments were undertaken accordingly.

2.2.4 Aquatic Habitat Assessment

An assessment of aquatic habitats was undertaken for creeks and drainage lines traversed by the assessed areas of the amended pipeline route. A number of features were noted at each crossing and these included topography, water level, riparian vegetation, stream width, instream features, apparent water quality and riparian zone condition.

2.3 Impact Assessment

As required for Part 3A of the EP&A Act the project impact assessment was undertaken in accordance with the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007). As requested by the Department of Planning, Assessments of Significance were also undertaken for species, populations and communities of conservation value.

An assessment was also undertaken of the impacts of the project on ecological communities, populations and species listed under the EPBC Act using the Significant Impact Criteria detailed in the *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines: Matters of National Environmental Significance* (DEH 2006).

Note that for the purposes of the impact assessment, the 'project' refers only to the portions of the project assessed in this report (refer Figures 1 - 8).

2.4 Limitations

All ecological assessments have limitations to the efficacy of the study. Of particular relevance to this study was that this assessment was largely based on predictive modelling using habitat assessment as it was undertaken over a short time period. Targeted surveys could not be undertaken limiting species records to incidental sightings. Adding to this, the field investigation was undertaken during a single season, again limiting the likelihood of opportunistic sightings as species may either be resident or transitory, whilst some species may have been inactive, dormant or with cryptic habits, and some may be nomadic or migratory in nature. Additionally, some fauna species are mobile or transient in their use of resources. Therefore, not all species, either resident or transitory, would have been recorded during the single assessment event.

This assessment was aimed at providing an overall assessment of the ecological values of the amended areas of the GFDA and pipeline route with particular emphasis on the likely occurrence of threatened species. In line with the central tenet of the precautionary principle it was assumed that if habitat was present for a threatened species then it was considered that the threatened species could potentially occur and assessments were made accordingly.

3 RESULTS

This report aims to describe the ecological values of the additional Stage 1 GFDA extension, the amended pipeline route and to provide clarification of three areas previously assessed. AECOM (2009) provides a broader ecological analysis of the project and its environmental setting, and consequently should be read in conjunction with this Addendum Report.

The amended sections of the proposed pipeline total approximately 26 km of which approximately 5.5 km contain remnant or regrowth vegetation. The majority of the native vegetation along the proposed pipeline route falls within the *Hunter-Macleay Dry Sclerophyll Forests* vegetation class which are transitional between the *Dry Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests* of the steeper and wetter slopes (Keith 2004). The canopy vegetation is largely dominated by Spotted Gum (*Corymbia maculata*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Grey Box (*E. moluccana*), Grey Gum (*E. punctata*), Small-fruited Grey Gum (*E. propinqua*) and Grey Ironbark (*E. siderophloia*). Shrubs are characterised by Silver-stemmed Wattle (*Acacia parvipinnula*), Forest Oak (*Allocasuarina torulosa*), Coffee Bush (*Breynia oblongifolia*), Gorse Bitter Pea (*Daviesia ulicifolia*) and Peach Heath (*Lissanthe strigosa*). White Root (*Pratia purpurascens*), Mulga Fern (*Cheilanthes sieberi subsp. sieberi*), Barbed Wire Grass (*Cymbopogon refractus*), Kangaroo Grass (*Themeda australis*) and Wiry Panic (*Entolasia stricta*) dominate the understorey. These areas grade into the mostly cleared, lower elevation areas of higher rainfall along the lower sections of the proposed pipeline. These areas become more saline-influenced closer to the Hunter River floodplain.

A précis of the findings for each assessment area of the amended pipeline is provided below and includes dominant flora species. A more detailed list of flora species recorded along the proposed pipeline route is provided in Appendix A.

3.1 Stage 1 GFDA Extension

3.1.1 General

Sections of the GFDA have previously been mapped by NPWS (1999) as *Ecosystem (ES) 145 Sydney Peppermint – Stringybark*, *ES 71 Ironbark*, *ES 47 Escarpment Redgum* and *ES 33 Dry Foothills Spotted Gum*. Well sites would be chosen to avoid intact native vegetation and consequently none of these vegetation communities would be removed during construction.

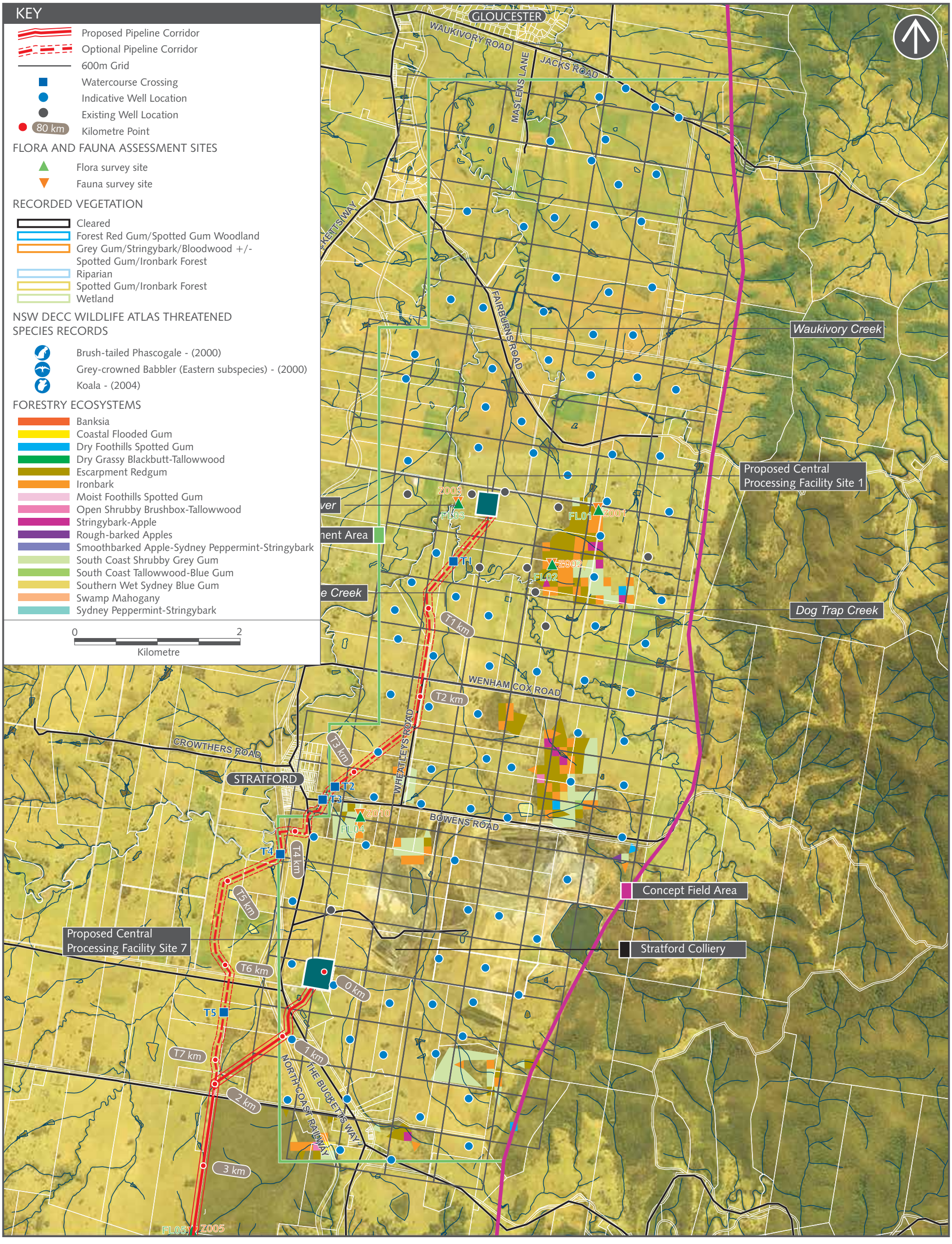
The Stage 1 GFDA extension is located along the south-western and southern boundaries and along the entire eastern boundary of the original GFDA (Figure 2). The location of the revised proposed well sites within this area are confined to the southern half of the GFDA and are all within modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and have been used for grazing over a considerable number of years. None of the proposed sites contain remnant native shrubs or trees and none would be located in riparian areas or within seepage zones although some access roads would cross drainage lines.

The lack of structural diversity of the sites means that fauna habitat resources, such as trees, shrubs, rocky areas and fallen timber, are extremely limited and in general, habitat suitable for fauna would generally be limited to those common species of native and introduced fauna regularly found in disturbed areas. However, the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) which is

listed as vulnerable under the TSC Act, is common to the Gloucester area and is often recorded in roadside reserves and woodland reserves. This Babbler was recorded (Figure 2) within a wooded area adjacent to the gathering lines of the proposed south-eastern most well and it is likely that this species would occur along the access tracks and adjacent woodlands of several of the other well sites.

3.1.2 Summary of Key Ecological Features of the Stage 1 GFDA Extension

- Native vegetation nearby;
- A number of drainage lines would be traversed; and
- Grey-crowned Babbler recorded in adjacent vegetation.



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FLORA AND FAUNA ASSESSMENT SITES, RECORDED VEGETATION ALONG PIPELINE ROUTE, NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS, FORESTRY ECOSYSTEMS AND WATERCOURSE CROSSINGS - STAGE 1 GAS FIELD DEVELOPMENT AREA

FIGURE 2

3.2 Amended Pipeline Rev E KP 17 - 25

This section of the proposed pipeline traverses cleared paddocks, woodlands and several drainage lines (Figure 3 and Figure 4).

3.2.1 Vegetation

There is no previous mapping provided by NPWS (1999) for this section of the proposed pipeline. Woodland communities along this section of the amended pipeline route have been mapped in this study as *Spotted Gum – Ironbark Forest* due to the dominance of Spotted Gum (*Corymbia maculata*) and Narrow-leaved Ironbark (*Eucalyptus crebra*).

Spotted Gum – Ironbark Forest occurs between KP 18 and 20. Grey Gum (*Eucalyptus punctata*), and Grey Box (*Eucalyptus moluccana*) also occur sporadically and on occasion become co-dominant. Most of these trees are regrowth although there are some fully mature specimens throughout especially along the ridgeline at KP 20. The shrub layer of the *Spotted Gum – Ironbark Forest* is dominated by Peach Heath, Coffee Bush, Prickly Moses (*Acacia ulicifolia*), Blackthorn (*Bursaria spinosa*) and Cherry Ballart (*Exocarpos cupressiformis)*. The ground layer is comprised of Mulga Fern, Barbed Wire Grass, Bordered Panic (*Entolasia marginata*), *Glycine clandestina*, Blady Grass (*Imperata cylindrica*) and Dusky Coral Pea (*Kennedia rubicunda*). Weed species are relatively infrequent but occasional infestations of Lantana (*Lantana camara*) and Blackberry (*Rubus fruiticosus*) occur in places as does Veined Verbena (*Verbena rigida*), Fireweed (*Senecio madagascariensis*) and a range of flat weeds, all of which are recognised as agricultural weeds.

The remaining pipeline route from approximately KP 20 – 25 traverses rolling paddocks containing scattered paddock trees and several steep sided ridges, two of which are vegetated with stands of trees. Of particular note is the steep ridge at KP 23 which is well vegetated with Spotted Gum, Grey Gum and Grey Box. This areas is used by cattle as a camp and consequently the understorey is largely absent although Kangaroo Grass was present throughout, as was fallen timber. Although largely isolated from other patches of trees there is a loose connection to vegetation to the east and Mammy Johnsons River via sparsely scattered eucalypts.

3.2.2 Fauna habitat

The lack of structural diversity of the cleared paddocks means that fauna habitat resources, such as trees, shrubs, rocky areas and fallen timber, are extremely limited and in general, habitat suitable for fauna would be limited to those common species of native and introduced fauna regularly found in disturbed areas.

However, the generally intact remnant and regrowth vegetation communities would provide good quality habitat for a range of native fauna including macropods, microchiropteran bats, some arboreal mammals and woodland birds. Macropod scats were recorded along the proposed pipeline route and the Eastern Grey Kangaroo (*Macropus giganteus*) and Eastern Wallaroo (*Macropus robustus*) were both sighted. Cattle pats scattered along the pipeline indicated that many of these areas are currently used for grazing of cattle (*Bos taurus*). Scratches on some of the smooth barked Eucalypts indicate that these trees were being used by arboreal mammals. Hollows were evident in some of the larger trees and these could provide habitat suitable for hollow-dependent birds, possums, gliders and microchiropteran bats.

This section of the pipeline route is a part of a patch of vegetation that would provide east – west stepping stone habitat for mobile and dispersing fauna and flora. Although densely vegetated links do not occur, scattered paddock trees and riparian vegetation along Karuah River, Mammy Johnsons River, creeks and other drainage lines would provide loose but adequate connections for some species between densely vegetated areas within Buckleys Range, Copper Mine Ridge and vegetation beyond.

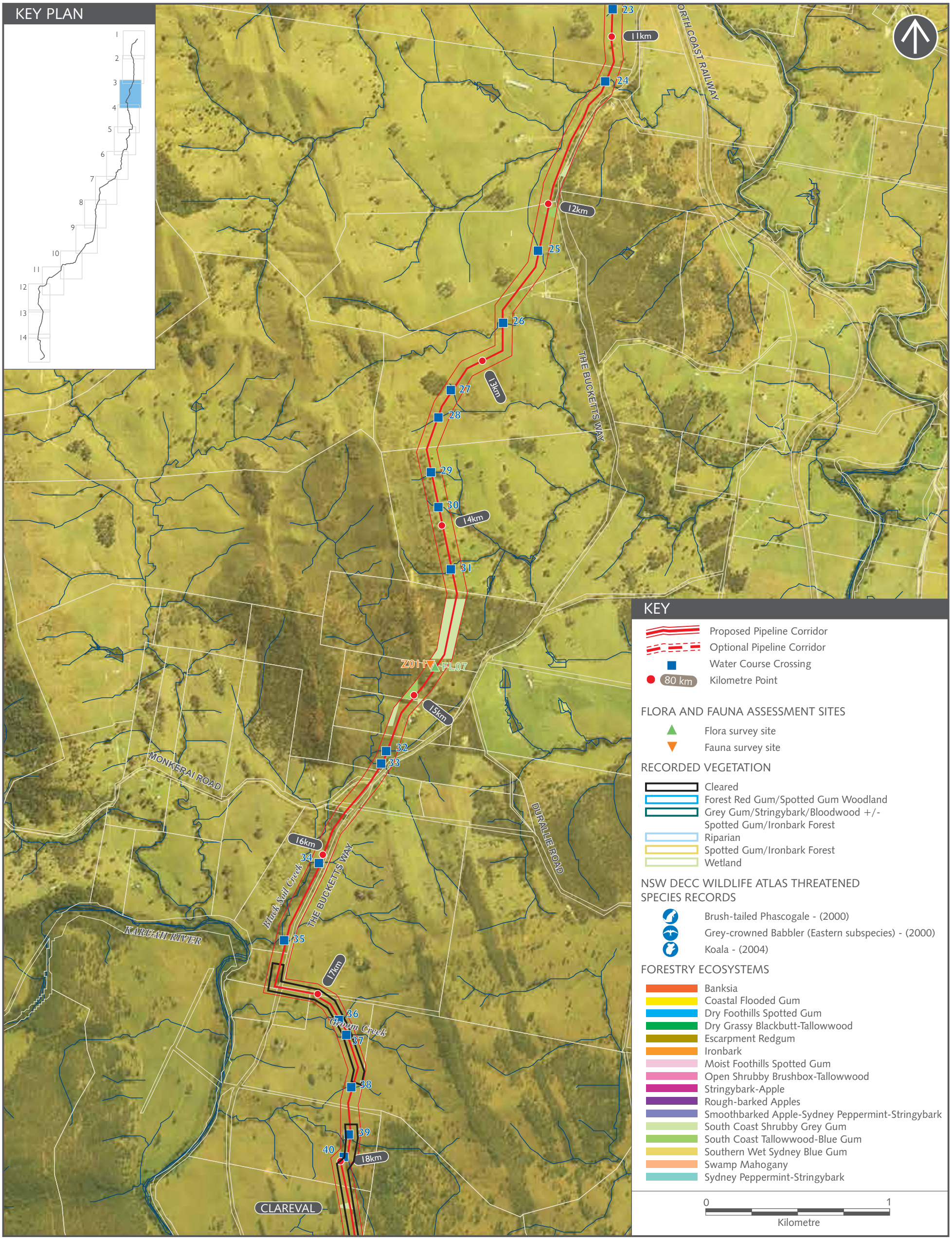
3.2.3 Aquatic environments

Groom Creek and several drainage lines which drain into the Karuah River occur along this section of the proposed pipeline route. The majority of these drainage lines are broad and eroded, grassed or bare ground gullies, the majority of which show signs of pugging by cattle. Common species within these drainage lines included Blady Grass, Spear Thistle (*Cirsium vulgare*), Giant Parramatta Grass (*Sporobolus fertilis*) and *Carex* sp. There were several steeper sided eroded channels that were better vegetated and these supported species such as Grey Gum, Prickly-leaved Tea Tree (*Melaleuca styphelioides*), Grey Myrtle (*Backhousia myrtifolia*), Native Raspberry (*Rubus parvifolius*), Maidenhair Fern (*Adiantum aethiopicum*), Silver-stemmed Wattle, Peach Heath, Kidney Weed (*Dichondron repens*), *Carex* sp. and large areas of Lantana. The catchment area of this section of the pipeline route is reality small due to the steepness of the ridgeline to the east of the pipeline route. The pipeline traverses the headwaters of a number of these drainage lines. Whilst the majority of the drainage lines had no flow at the time of the assessment, headwaters are considered to be important sites for processing of organic matter and nutrient cycling and are thought to contribute to the maintenance of health of whole river networks (various authors cited in Clarke *et al*. 2008). Several small farm dams occur nearby to the proposed pipeline route. These are mostly unvegetated areas and these would be avoided.

3.2.4 Summary of Key Ecological Features of Amended Pipeline KP 17 – 25

- Route passes through native vegetation; and
- The headwaters of a number of drainage lines would be traversed.

KEY PLAN



KEY

- Proposed Pipeline Corridor
- Optional Pipeline Corridor
- Water Course Crossing
- 80 km Kilometre Point

FLORA AND FAUNA ASSESSMENT SITES

- Flora survey site
- Fauna survey site

RECORDED VEGETATION

- Cleared
- Forest Red Gum/Spotted Gum Woodland
- Grey Gum/Stringybark/Bloodwood +/- Spotted Gum/Ironbark Forest
- Riparian
- Spotted Gum/Ironbark Forest
- Wetland

NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS

- Brush-tailed Phascogale - (2000)
- Grey-crowned Babbler (Eastern subspecies) - (2000)
- Koala - (2004)

FORESTRY ECOSYSTEMS

- Banksia
- Coastal Flooded Gum
- Dry Foothills Spotted Gum
- Dry Grassy Blackbutt-Tallowwood
- Escarpment Redgum
- Ironbark
- Moist Foothills Spotted Gum
- Open Shrubby Brushbox-Tallowwood
- Stringybark-Apple
- Rough-barked Apples
- Smoothbarked Apple-Sydney Peppermint-Stringybark
- South Coast Shrubby Grey Gum
- South Coast Tallowwood-Blue Gum
- Southern Wet Sydney Blue Gum
- Swamp Mahogany
- Sydney Peppermint-Stringybark

0 1
Kilometre

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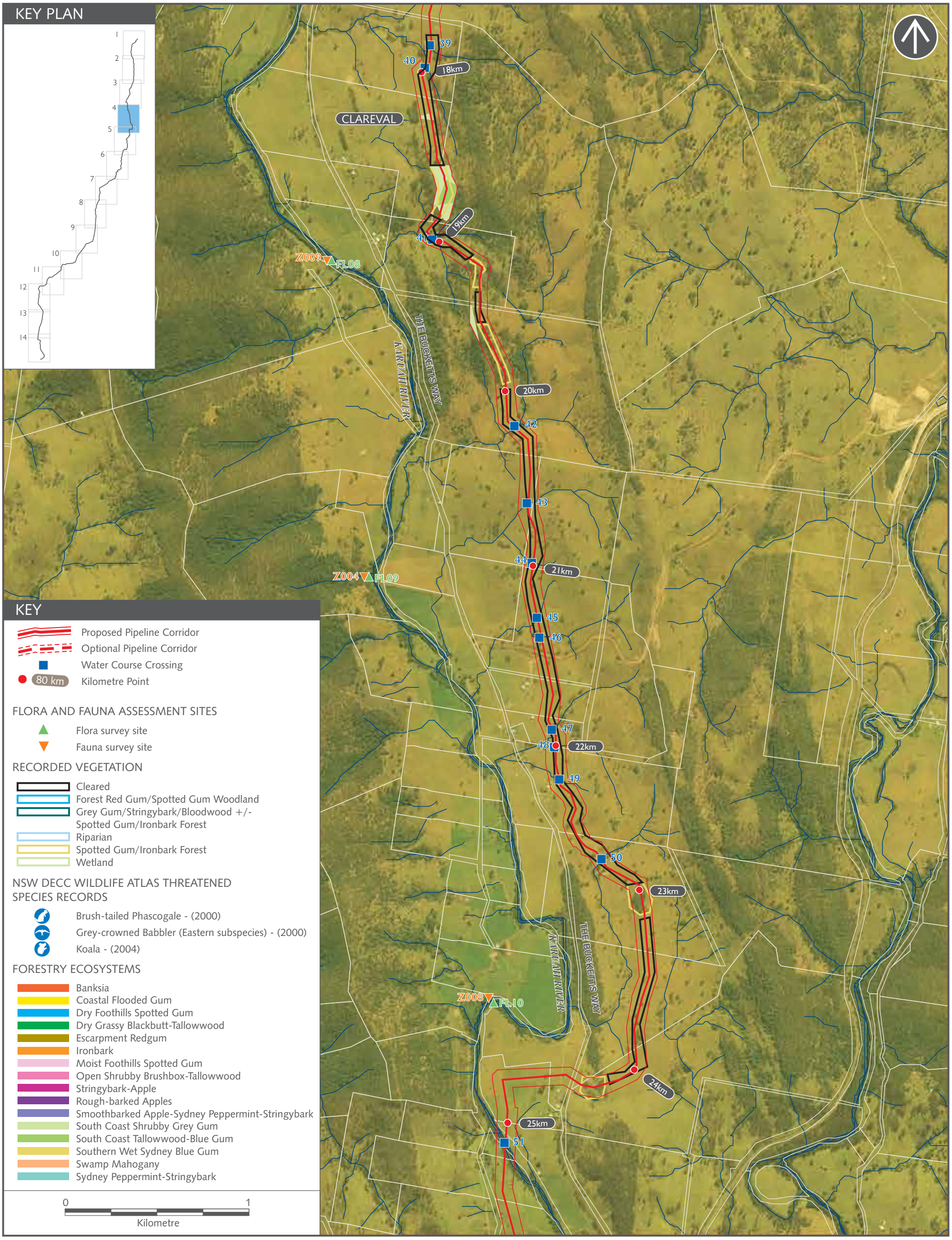
FLORA AND FAUNA ASSESSMENT SITES AND NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS AND FORESTRY ECOSYSTEMS ALONG PIPELINE ROUTE KILOMETRE POINT 11 - 18KM

FIGURE 3



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FLORA AND FAUNA ASSESSMENT SITES AND NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS AND FORESTRY ECOSYSTEMS ALONG PIPELINE ROUTE KILOMETRE POINT18 - 25KM

FIGURE 4

3.3 Amended Pipeline Route Rev E KP 27.5

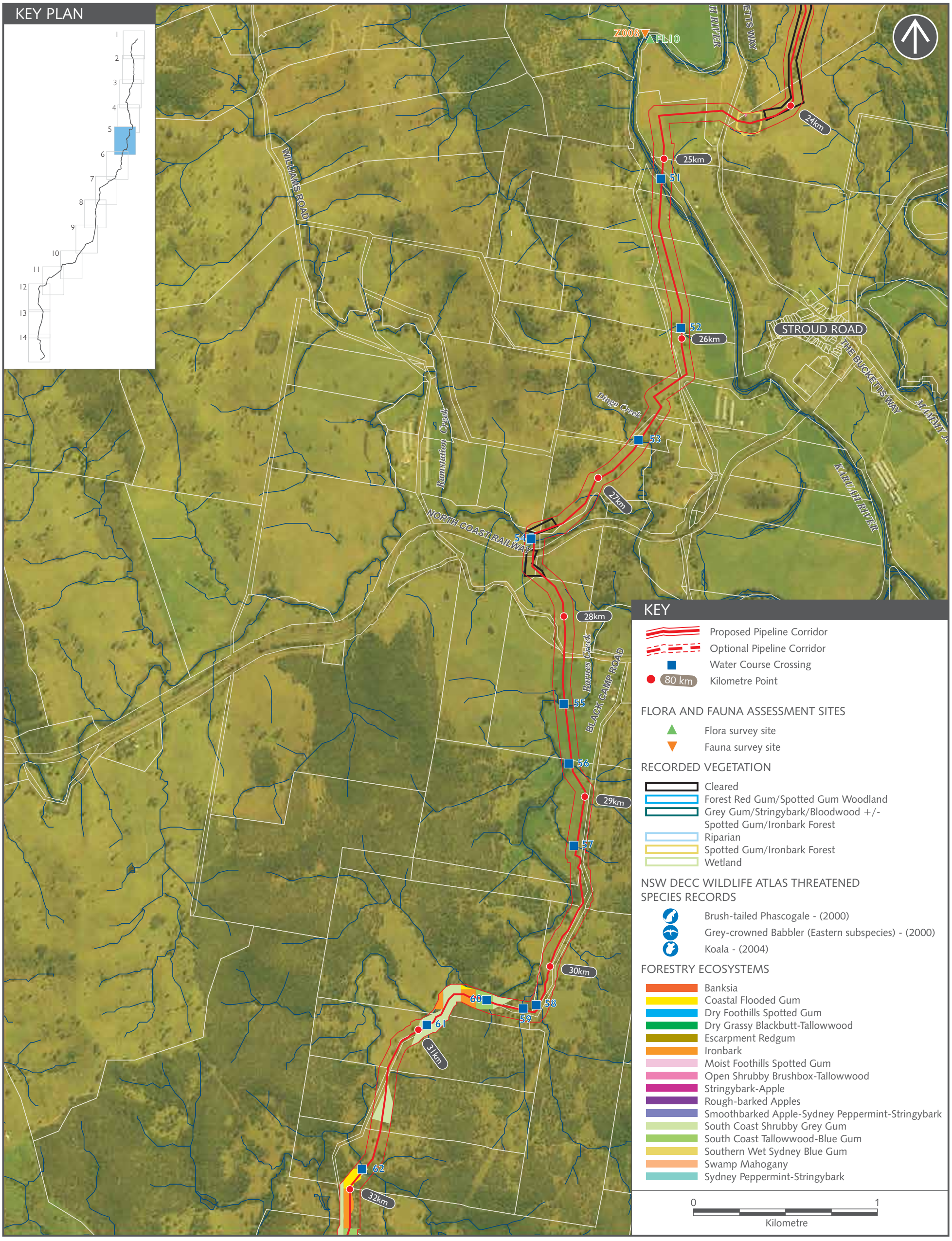
The pipeline route was amended near KP 27.5 to cross Ramstation Creek (Figure 5) approximately 250 m to the west of the Rev C alignment. The approach to the new point of crossing passes through a paddock and crosses an open area between a patch of Forest Red Gum saplings (*Eucalyptus tereticornis*) and Flax-leaved Paperbark (*Melaleuca linariifolia*) on the floodplain.

The riparian area of Ramstation Creek has been cleared and any vegetation remaining occurs below the top of bank. At the point of crossing, the creek channel is approximately 15 m wide and 4 m deep. The sides are comprised of compacted silt material and are badly eroded. On the day of assessment the creek was flowing gently and several snags were present along the reach. Cattle access the creek and this activity may have contributed to the degree of erosion. A small terrace area down from the top of bank was infested with Stinging Nettles. The remaining riparian vegetation was dominated by Spiny-headed Mat-rush (*Lomandra longifolia*), Maidenhair, Grey Myrtle with River Oak (*Casuarina cunninghamiana*) occurring nearby. On the southern side of the creek the pipeline would traverse a small area of paddock before traversing a railway line.

3.3.1 Summary of Key Ecological Features of Amended Pipeline KP 27.5

- Riparian areas and aquatic environment of Ramstation Creek.

KEY PLAN



KEY

- Proposed Pipeline Corridor
- Optional Pipeline Corridor
- Water Course Crossing
- 80 km Kilometre Point

FLORA AND FAUNA ASSESSMENT SITES

- Flora survey site
- Fauna survey site

RECORDED VEGETATION

- Cleared
- Forest Red Gum/Spotted Gum Woodland
- Grey Gum/Stringybark/Bloodwood +/- Spotted Gum/Ironbark Forest
- Riparian
- Spotted Gum/Ironbark Forest
- Wetland

NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS

- Brush-tailed Phascogale - (2000)
- Grey-crowned Babbler (Eastern subspecies) - (2000)
- Koala - (2004)

FORESTRY ECOSYSTEMS

- Banksia
- Coastal Flooded Gum
- Dry Foothills Spotted Gum
- Dry Grassy Blackbutt-Tallowwood
- Escarpment Redgum
- Ironbark
- Moist Foothills Spotted Gum
- Open Shrubby Brushbox-Tallowwood
- Stringybark-Apple
- Rough-barked Apples
- Smoothbarked Apple-Sydney Peppermint-Stringybark
- South Coast Shrubby Grey Gum
- South Coast Tallowwood-Blue Gum
- Southern Wet Sydney Blue Gum
- Swamp Mahogany
- Sydney Peppermint-Stringybark

0 1
Kilometre

AECOM

FLORA AND FAUNA ASSESSMENT SITES AND NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS AND FORESTRY ECOSYSTEMS ALONG PIPELINE ROUTE KILOMETRE POINT 25 - 32KM

FIGURE 5

3.4 Amended Pipeline Rev E KP 71.5 - 83

This section of the proposed pipeline traverses several landscape types including cleared paddocks, swampy ground and well vegetated areas (Figure 6, Figure 7, Figure 9 and Figure 11).

3.4.1 Vegetation

Areas between KP 71.5 and 73.8 and KP 76 and 77 have previously been mapped as *SE 71 Ironbark* and *SE 134 South Coast Shrubby Grey Gum* by NPWS (1999).

The proposed pipeline route between KP 71.5 and 73.8 traverses a steep and rocky ridgeline and partly follows a powerline easement bordered by intact and mature forest. Canopy species along this section are generally dominated by Spotted Gum and Ironbark with Grey Gum, Bloodwood, Red Gum and Grey Box grading in and out of co-dominance depending on drainage and elevation. Much of this area is densely infested with Lantana although in other areas, especially nearer KP 74, there is an intact understorey. Shrub species are characterised by Peach Heath, Prickly Moses, Blackthorn, Dogwood (*Jacksonia scoparia*) and Prickly Beard-heath (*Leucopogon juniperinus*). Groundcover species were also diverse in places and included, Mulga Fern, Blady Grass, Old Man's Beard (*Clematis aristata*), Purple Coral Pea (*Hardenbergia violacea*), Blue Flax-lily (*Dianella caerulea var. producta*), Wiry Panic, *Glycine tabacina*, Dusky Coral Pea, Whiteroot, Barbed Wire Grass, Threeawn Speargrass (*Aristida vagans*) and *Drosera* sp.

From KP 76 to 78 the pipeline route passes through paddocks and adjacent to a remnant patch of woodland at around KP 75.4 and through another remnant woodland patch at KP 76. Both of these woodland patches are dominated by mature Spotted Gum, Forest Red Gum, Grey Gum, Grey Box and Ironbark. Trees are large and mature in both woodland patches. However, the woodland remnant at KP 75.4 contains a number of very large and old specimens and has a largely intact grassy understorey characterised by Wiry Panic, Bordered Panic, Kangaroo Grass, Whiteroot, Mulga Fern, Prickly Moses and Blackthorn. Weed species included Lantana, Apple of Sodom (*Solanum linnaeanum*) and Fireweed. The woodland at around KP 76 is more degraded with the understorey almost completely comprised of introduced pasture species and fewer signs of saplings growing throughout which is likely to reflect the differences in grazing history.

It is likely that these two woodland remnants are characteristic of *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions*, an EEC listed under the TSC Act (see Section 3.7.2).

From KP 77 to 83 the proposed pipeline route traverses low-lying paddocks. It passes close to paddock trees and clumps of vegetation which is characteristic of poorly drained areas such as River Oak and Flax-leaved Paperbark. Other species present within the paddocks were Kikuyu (*Pennisetum clandestinum*), *Carex* sp. and *Juncus pallidus* and the dominance of each varied with the degree of waterlogging of the paddock.

3.4.2 Fauna habitat

The proposed pipeline route between KP 71.5 and 73.5 traverses the edge of intact forest which is contiguous with a large tract of vegetation to the west. Consequently, this area could provide habitat for a wide range of fauna, especially those which have large home ranges or particular habitat requirements provided by steep and rocky country. There were several areas of exposed rock

benches and these would also provide ideal basking habitat for reptiles especially given that well vegetated areas occur nearby. The remnant woodland patches and paddock trees which occur along the pipeline route are more isolated and degraded and consequently these would most likely provide habitat for more mobile species such as woodland birds and microchiropteran bats. The open paddock areas would also provide habitat for water birds during times of inundation.

The two patches of remnant *Hunter Lowland Redgum Forest* and Deadmans Creek (see Section 3.4.3) are mapped as Koala habitat in the *Port Stephens Council Comprehensive Koala Plan of Management*.(CKPoM; Port Stephens Council 2002) The importance of these areas as Koala habitat is discussed further in Section 3.7.6.

3.4.3 Aquatic environments

This section of the proposed pipeline route traverses several drainage lines, channels and passes nearby to small farm dams.

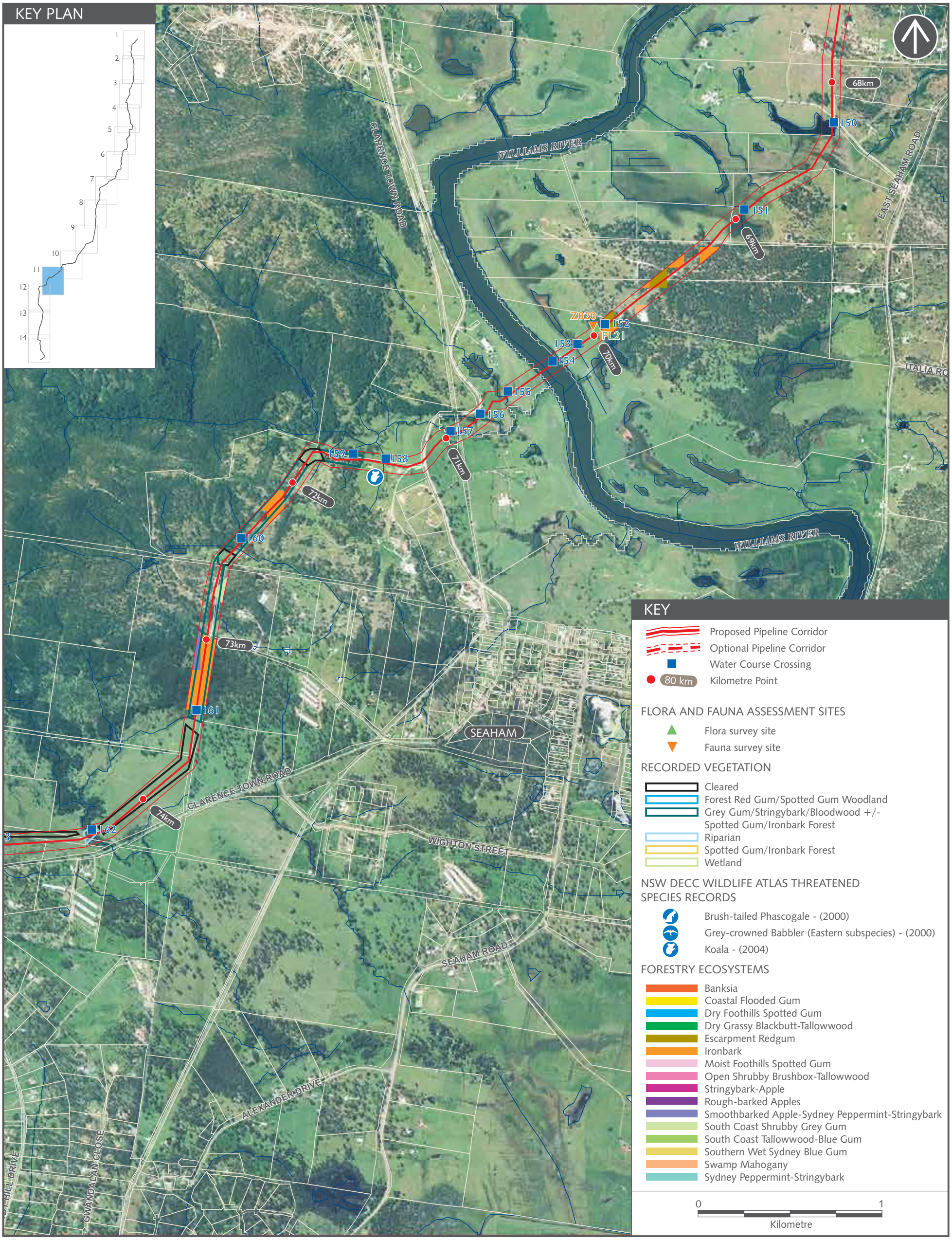
The most substantial of the creek crossings is Deadmans Creek located at approximately KP 74.3. Although disturbed, this creek contains several small pools and instream vegetation such as Slender Knotweed (*Persicaria decipien*s). The pools are connected by 'runs' and on the day of assessment water was flowing between the pools. Brown algae covers some sections of the banks and snags indicating nutrient enrichment. Some sections of the banks are infested with Lantana and Blackberry but in general there is relatively good diversity within the riparian area. Vegetation is characterised by Green Wattle (*Acacia parramattensis*), Common Bracken (*Pteridium esculentum*), Whiteroot, Kidney Weed, Prickly-leaved Tea Tree, Common Silkpod (*Parsonsia straminea*), Blackthorn, Broad-leaved White Mahogany (*Eucalyptus umbra*), Mulga Fern, Peach Heath, Old Man's Beard, Weeping Grass (*Microlaena stipoides*), Forest Red Gum, Cheese Tree (*Glochidion ferdinandi*) and Grey Myrtle.

The remaining drainage line crossings are characterised by open eroded channels largely devoid of vegetation other than weeds and agricultural grasses. The low-lying areas from KP 77 to 83 were waterlogged on the day of assessment although no standing water was evident. Several small farm dams also occur nearby to the proposed pipeline route. These are mostly unvegetated areas that would be avoided.

3.4.4 Summary of Key Ecological Features of Amended Pipeline KP 71.5 - 83

- Intact remnant vegetation;
- *Hunter Lowland Redgum Forest* – EEC;
- EEC remnants also mapped as 'Marginal Koala Habitat' under the *Port Stephens Council CKPoM* (Port Stephens Council 2002);
- Riparian areas and aquatic environment of Deadmans Creek; and
- Deadmans Creek mapped as 'Preferred Koala Habitat' under the *Port Stephens Council CKPoM* (Port Stephens Council 2002).

KEY PLAN



KEY

- Proposed Pipeline Corridor
- Optional Pipeline Corridor
- Water Course Crossing
- 80 km — Kilometre Point

FLORA AND FAUNA ASSESSMENT SITES

- Flora survey site
- Fauna survey site

RECORDED VEGETATION

- Cleared
- Forest Red Gum/Spotted Gum Woodland
- Grey Gum/Stringybark/Bloodwood +/- Spotted Gum/Ironbark Forest
- Riparian
- Spotted Gum/Ironbark Forest
- Wetland

NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS

- Brush-tailed Phascogale - (2000)
- Grey-crowned Babbler (Eastern subspecies) - (2000)
- Koala - (2004)

FORESTRY ECOSYSTEMS

- Banksia
- Coastal Flooded Gum
- Dry Foothills Spotted Gum
- Dry Grassy Blackbutt-Tallowwood
- Escarpment Redgum
- Ironbark
- Moist Foothills Spotted Gum
- Open Shrubby Brushbox-Tallowwood
- Stringybark-Apple
- Rough-barked Apples
- Smoothbarked Apple-Sydney Peppermint-Stringybark
- South Coast Shrubby Grey Gum
- South Coast Tallowwood-Blue Gum
- Southern Wet Sydney Blue Gum
- Swamp Mahogany
- Sydney Peppermint-Stringybark

0 — 1
Kilometre

AECOM

FLORA AND FAUNA ASSESSMENT SITES AND NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS AND FORESTRY ECOSYSTEMS ALONG PIPELINE ROUTE KILOMETRE POINT 68 - 74KM

FIGURE 6

KEY PLAN

KEY

- Proposed Pipeline Corridor
- Optional Pipeline Corridor
- Water Course Crossing
- 80 km Kilometre Point

FLORA AND FAUNA ASSESSMENT SITES

- Flora survey site
- Fauna survey site

RECORDED VEGETATION

- Cleared
- Forest Red Gum/Spotted Gum Woodland
- Grey Gum/Stringybark/Bloodwood +/- Spotted Gum/Ironbark Forest
- Riparian
- Spotted Gum/Ironbark Forest
- Wetland

NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS

- Brush-tailed Phascogale - (2000)
- Grey-crowned Babbler (Eastern subspecies) - (2000)
- Koala - (2004)

FORESTRY ECOSYSTEMS

- Banksia
- Coastal Flooded Gum
- Dry Foothills Spotted Gum
- Dry Grassy Blackbutt-Tallowwood
- Escarpment Redgum
- Ironbark
- Moist Foothills Spotted Gum
- Open Shrubby Brushbox-Tallowwood
- Stringybark-Apple
- Rough-barked Apples
- Smoothbarked Apple-Sydney Peppermint-Stringybark
- South Coast Shrubby Grey Gum
- South Coast Tallowwood-Blue Gum
- Southern Wet Sydney Blue Gum
- Swamp Mahogany
- Sydney Peppermint-Stringybark

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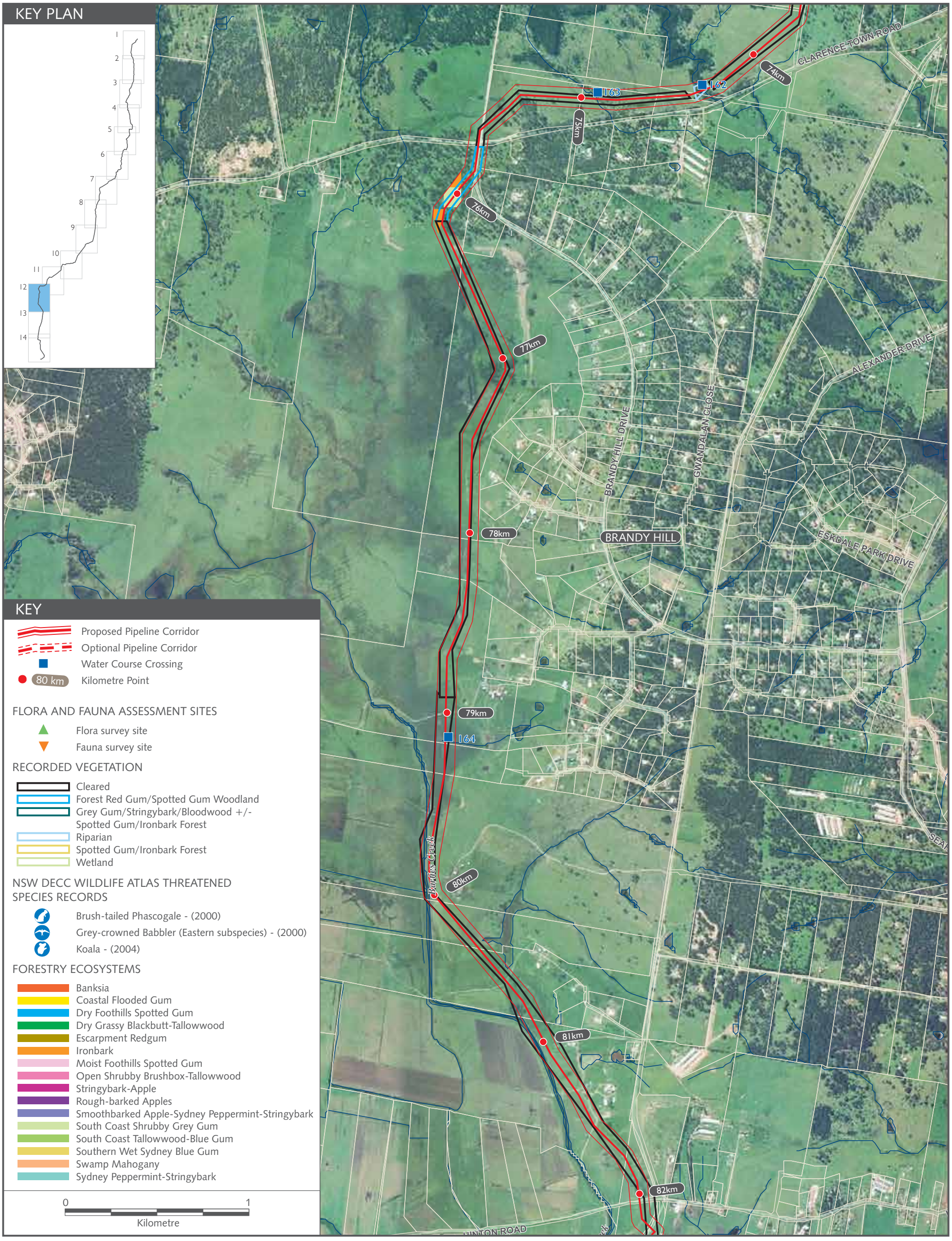
Kilometre



AECOM

FLORA AND FAUNA ASSESSMENT SITES AND NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS AND FORESTRY ECOSYSTEMS ALONG PIPELINE ROUTE KILOMETRE POINT 74 - 82KM

FIGURE 7

3.5 Amended Pipeline Rev E KP 89.5 - 95

This section of the proposed pipeline traverses several landscape types which include cleared paddocks, swampy ground and two SEPP 14 Coastal Wetlands (Figure 8 and Figure 11). HDD would be used to pass under the Hunter River and SEPP 14 wetlands.

3.5.1 Vegetation

Freshwater Wetland Complex was mapped by LHCCREMS (NPWS 2000) as occurring between KP 89.5 and 90. Ground-verification of this mapping showed that the areas mapped as *Freshwater Wetland Complex* were Kikuyu dominated pastures used for cattle grazing.

At approximately KP 89.1 the proposed pipeline passes adjacent to an area mapped by AECOM (2009) as *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* (an EEC) before heading south through cleared paddocks and through gaps between several groups of Swamp Oak (*Casuarina glauca*) and paperbark trees (*Melaleuca* spp.) to approximately KP 92.4 where it crosses the north arm of the Hunter River. Tomago SEPP 14 Coastal Wetlands No. 830 and 831 are located on the southern side of the Hunter River, both of which contain reedlands, saltmarsh and mangrove communities. Adjacent to Wetland No. 831 is a caravan park located on a raised platform of fill which has been grassed and landscaped with Weeping Willows (*Salix babylonica*), Radiata Pines (*Pinus radiata*) and other common landscaping species. The surrounding areas at the base of the fill batters appear to be used as an illegal dumping site for building and household refuse. The proposed pipeline route joins Old Punt Road adjacent to the SEPP 14 Wetland No. 831. The boundary of this wetland is bordered by weeds such as Whisky Grass (*Andropogon virginicus*), Lantana, Sharp Rush (*Juncus acutus*), Kikuyu and Pampas Grass (*Cortaderia selloana*). The proposed pipeline route then crosses the north arm of the Hunter River again and emerges at Hexham.

3.5.2 Fauna habitat

The Tomago Wetlands and the Hunter River north arm are upstream of the Hunter Estuary National Park. Kooragang Island, Hunter Estuary, Hexham Swamp, and a section of Ash Island form part of the Hunter Estuary National Park (formerly the Kooragang Nature Reserve) and these areas are known to support significant fauna habitat including:

- SEPP14 Wetlands 830 and 831;
- Hunter Estuary National Park;
- Tidal creeks;
- Green and Golden Bell Frog (*Litoria aurea*) habitat (TSC and EPBC Act listed species);
- Grass Owl (*Tyto capensis*) habitat (TSC Act listed species);
- Migratory wader habitat (many of which are protected under the EPBC Act);
- Mangrove forests (protected under the FM Act); and
- Coastal Saltmarsh (EEC listed under the FM Act) areas within the wetlands and in the locality.

3.5.3 Aquatic environments

The amended pipeline route passes through paddocks, many of which appear to be drained using constructed earthen drainage channels. These areas are largely devoid of vegetation other than low growing pasture grasses and hence would not provide high quality fauna habitat due to their lack of complexity.

Tomago Wetlands (Coastal Wetlands No. 830 and 831) are upstream from Kooragang Island / Hunter Estuary which is known to provide internationally recognised water bird habitat as well as providing habitat for a number of threatened species listed under the TSC Act and EPBC Act.

3.5.4 Key Ecological Features of the Amended Pipeline KP 89.5 – 96

- Riparian area and aquatic habitat of the Hunter River;
- Internationally recognised migratory wader habitat;
- Hunter Estuary National Park is located downstream of the crossing points of the Hunter River north arm;
- SEPP 14 Coastal Wetlands No. 830 and 831;
- Adjacent Swamp Oak Floodplain Forest at KP 89.5;
- Listed migratory water bird habitat;
- Coastal Saltmarsh listed under the FM Act;
- Mangrove communities protected under the FM Act; and
- Threatened species including Grass Owl (TSC Act) and Green and Golden Bell Frog (TSC Act and EPBC Act).

KEY PLAN

KEY

- Proposed Pipeline Corridor
- Optional Pipeline Corridor
- Water Course Crossing
- 80 km Kilometre Point

FLORA AND FAUNA ASSESSMENT SITES

- Flora survey site
- Fauna survey site

RECORDED VEGETATION

- Cleared
- Forest Red Gum/Spotted Gum Woodland
- Grey Gum/Stringybark/Bloodwood +/- Spotted Gum/Ironbark Forest
- Riparian
- Spotted Gum/Ironbark Forest
- Wetland

NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS

- Brush-tailed Phascogale - (2000)
- Grey-crowned Babbler (Eastern subspecies) - (2000)
- Koala - (2004)

FORESTRY ECOSYSTEMS

- Banksia
- Coastal Flooded Gum
- Dry Foothills Spotted Gum
- Dry Grassy Blackbutt-Tallowwood
- Escarpment Redgum
- Ironbark
- Moist Foothills Spotted Gum
- Open Shrubby Brushbox-Tallowwood
- Stringybark-Apple
- Rough-barked Apples
- Smoothbarked Apple-Sydney Peppermint-Stringybark
- South Coast Shrubby Grey Gum
- South Coast Tallowwood-Blue Gum
- Southern Wet Sydney Blue Gum
- Swamp Mahogany
- Sydney Peppermint-Stringybark

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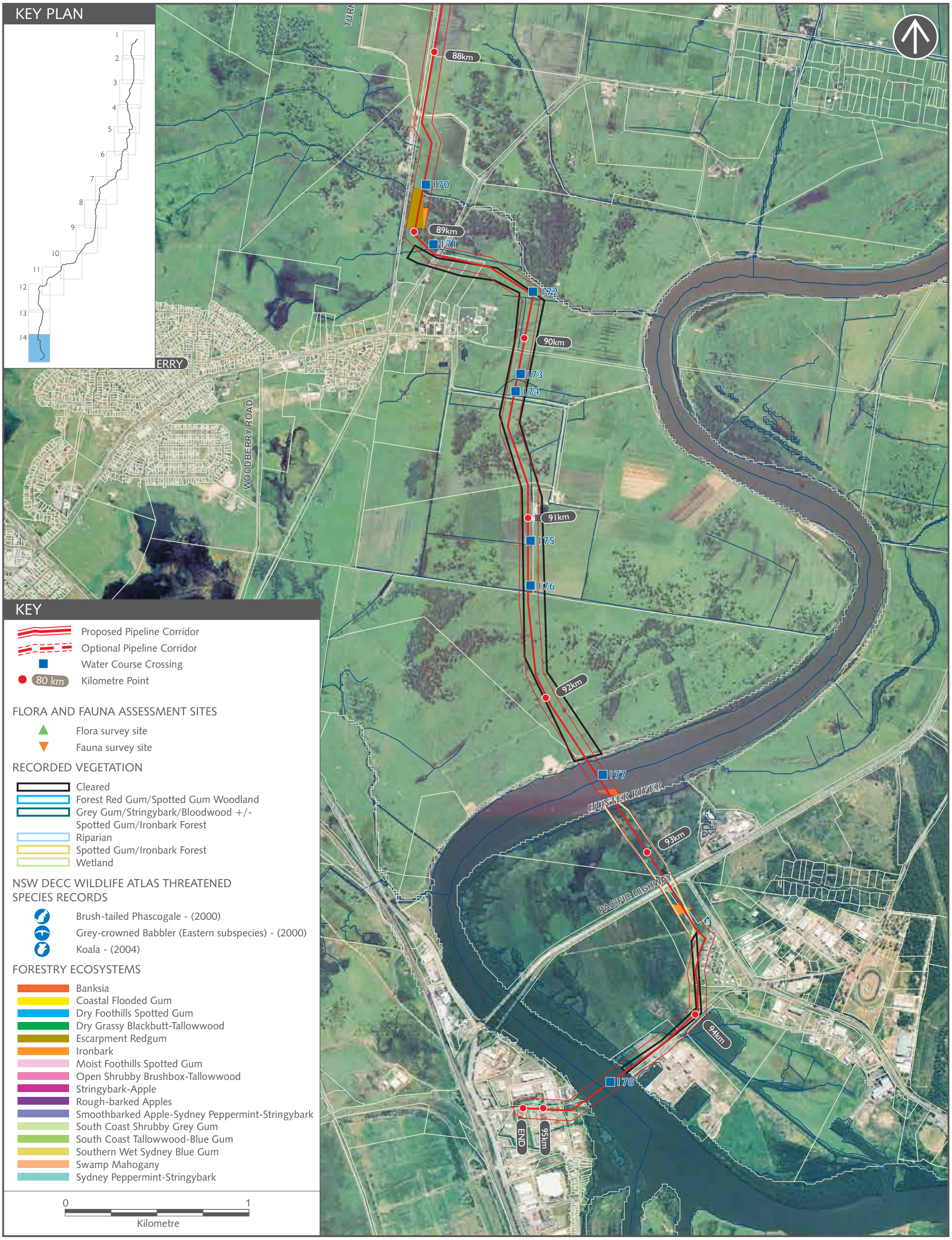
Kilometre

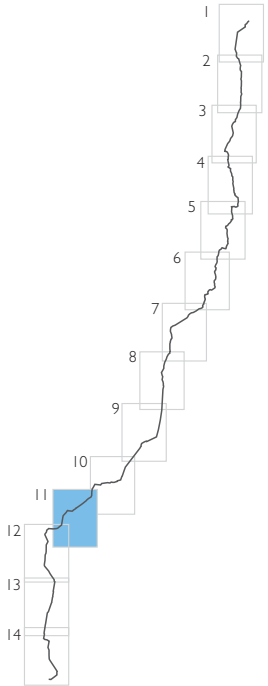


AECOM

FLORA AND FAUNA ASSESSMENT SITES AND NSW DECC WILDLIFE ATLAS THREATENED SPECIES RECORDS AND FORESTRY ECOSYSTEMS ALONG PIPELINE ROUTE KILOMETRE POINT 88 - END

FIGURE 8

KEY PLAN



WILLIAMS RIVER
CLARENCE TOWN ROAD
EAST SEAHAM ROAD
ITALIA RO
68km
69km
70km
71km
72km
73km
74km
150
151
152
153
154
155
156
157
158
159
160
161
162
SEAHAM
WIGHTON STREET
SEAHAM ROAD
ALEXANDER DRIVE
GWANDALAN CLOSE
HILL DRIVE

KEY

- Proposed Pipeline Corridor
- Water Course Crossing
- 80 km Kilometre Point

LHCCREMS Vegetation Mapping

- Alluvial Tall Moist Forest
- Freshwater Wetland Complex
- Hunter Lowland Redgum Forest
- Hunter Valley Dry Rainforest
- Hunter Valley Moist Forest
- Lower Hunter Spotted Gum - Ironbark Forest
- Seaham Spotted Gum Ironbark Forest
- Swamp Mahogany - Paperbark Forest
- Swamp Oak Rushland Forest
- Mangrove Estuarine Complex

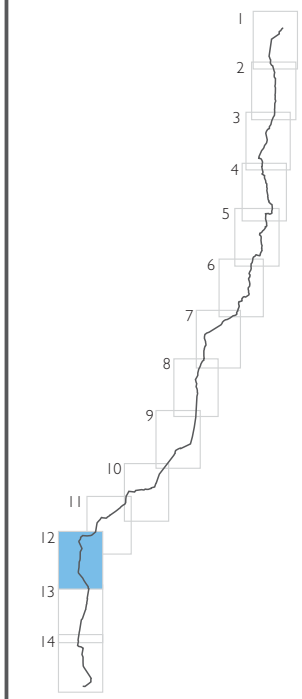
0 1
Kilometre

AECOM

EXTANT VEGETATION OF THE LOWER HUNTER & CENTRAL COAST
KILOMETRE POINT 68 - 74KM

FIGURE 9

KEY PLAN



CLARENCE TOWN ROAD
ALEXANDER DRIVE
BRANDY HILL DRIVE
GWANDALAN CLOSE
ESKDALE PARK DRIVE
BRANDY HILL
HINTON ROAD
Barties Creek
74km
75km
76km
77km
78km
79km
80km
81km
82km
162
163
164

KEY

- Proposed Pipeline Corridor
- Water Course Crossing
- 80 km Kilometre Point

LHCCREMS Vegetation Mapping

- Alluvial Tall Moist Forest
- Freshwater Wetland Complex
- Hunter Lowland Redgum Forest
- Hunter Valley Dry Rainforest
- Hunter Valley Moist Forest
- Lower Hunter Spotted Gum - Ironbark Forest
- Seaham Spotted Gum Ironbark Forest
- Swamp Mahogany - Paperbark Forest
- Swamp Oak Rushland Forest
- Mangrove Estuarine Complex

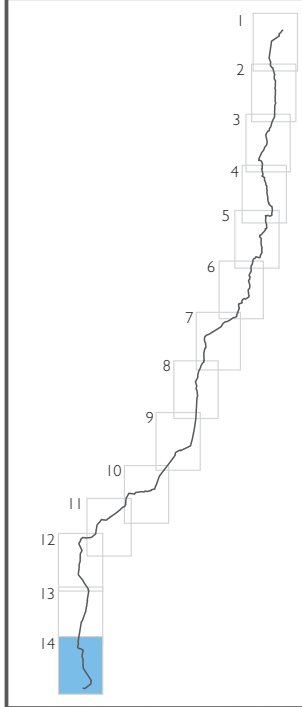
0 1
Kilometre

AECOM

EXTANT VEGETATION OF THE LOWER HUNTER & CENTRAL COAST
KILOMETRE POINT 74 - 82KM

FIGURE 10

KEY PLAN



88km
89km
90km
91km
92km
93km
94km
95km
END

170
171
172
173
174
175
176
177
178

WOODBERRY ROAD
MAIN NORTHERN RAILWAY
NEW ENGLAND HIGHWAY
HUNTER RIVER
PACIFIC HIGHWAY
TARRO

KEY

Proposed Pipeline Corridor
Water Course Crossing
80 km Kilometre Point

LHCCREMS Vegetation Mapping

- Alluvial Tall Moist Forest
- Freshwater Wetland Complex
- Hunter Lowland Redgum Forest
- Hunter Valley Dry Rainforest
- Hunter Valley Moist Forest
- Lower Hunter Spotted Gum - Ironbark Forest
- Seaham Spotted Gum Ironbark Forest
- Swamp Mahogany - Paperbark Forest
- Swamp Oak Rushland Forest
- Mangrove Estuarine Complex

0 1
Kilometre

AECOM

EXTANT VEGETATION OF THE LOWER HUNTER & CENTRAL COAST
KILOMETRE POINT 88 - END

FIGURE 11

3.6 Areas of Clarification

The ecological features of these areas have been clarified although no further impact assessment has been undertaken for these areas as they form part of the assessment undertaken by AECOM (2009).

3.6.1 Freshwater Wetlands Rev. C KP 68

An ephemeral wetland dominated by sedges was recorded along approximately 0.9 km of the pipeline route near the Williams River at Rev. C KP 68 (AECOM 2009, Fig 10.1.15). The pipeline would transect the wetland for approximately 0.15 km, an artificial drainage channel which is fringed by sedges for about 5 to 10 m and pass through cleared pasture just east of the wetland for 0.7 km (AECOM 2009). This ephemeral wetland was considered to be representative of *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*, an EEC listed under the TSC Act.

This area is most likely representative of this EEC. On-ground discussions at the time of reassessment resulted in the proposed pipeline route being relocated to the northern side of the powerline easement thus avoiding a large part of this wetland area and avoiding the most intact and diverse section altogether. However, where the proposed pipeline route traverses an additional wetland to the north at around KP Rev. C 67.3 it is recommended that this area be underbored using horizontal directional drilling (HDD) to avoid direct impacts.

3.6.2 Swamp Sclerophyll Forest Rev. C KP 69.5

Approximately 30 m of a paperbark swamp is traversed by the proposed pipeline at Rev. C KP 69.5 (AECOM 2009, Fig 10.1.15), just north of the Williams River. At this location a 10 m wide strip directly underneath a powerline has been completely cleared but 10 to 20 m on either side contain well established regenerating paperbark trees (AECOM 2009). This area is not only a SEPP 14 wetland but is also considered to be representative of *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*, an EEC listed under the TSC Act (AECOM 2009).

AECOM (2009) recommended that to reduce impacts on this EEC and SEPP 14 wetland, construction impacts should be confined to the powerline easement. A review of this recommendation has shown that from an engineering perspective that some clearing outside of the easement would be necessary. Consequently, a review of the potential impacts on this SEPP 14 wetland and EEC was sought.

This review found that this area is a highly sensitive area of conservation significance that should be avoided. The outcome of the on ground reassessment is that the entire area would be horizontally directionally drilled. The drilling platform would be located in an already cleared area at approximately Rev. C KP 68.8 and all direct impacts would be avoided.

3.6.3 Creek Crossing Rev. C KP 49.5

The pipeline route crosses a tributary of Bridge Creek at around Rev. C KP 49.5 (AECOM 2009, Fig 10.1.11) and would require the removal of around 0.08 ha of riparian vegetation. This removal could be avoided if HDD is used instead of open trenching of the pipeline. AECOM (2009) recommended that HDD be used at this crossing. Since then, an engineering assessment has determined that this

would not be possible. Consequently a review of the potential impacts on this creek and rainforest vegetation was sought.

This review found that the area of crossing would occur at the headwaters of this tributary. The approach to this creek is through paddocks used for cattle grazing. A very narrow band of riparian vegetation occurs along the top of bank and this is characterised by Grey Myrtle, Red Ash and Celery Wood (*Polyscias elegans*). However, Lantana dominated the shrub layer and Wandering Jew (*Tradescantia fluminensis*) was the dominant groundcover. The banks were eroded and showed signs of use by cattle. Mature trees are absent from the proposed crossing area but are present further downstream. At the time of assessment the cobble filled creek bed was dry. Upstream of the proposed crossing area are small but intact sandstone benches.

Crossing of the creek by open trenching at the proposed point could be undertaken provided that stringent environmental management measures are followed and these should include:

- Areas containing mature Eucalypt trees should be avoided;
- Clearing width should be minimised to 12 m;
- The sandstone benches at the headwater should be avoided and protected from any direct impacts;
- Cobbles from the creek bed should be collected, stockpiled and then reinstated after backfilling of the trench; and
- Trenching should be undertaken during dry weather to avoid the risk of erosion and sedimentation on habitats downstream.

3.7 Conservation Significance

The site and locality (i.e. 5 km buffer around the pipeline route) have a number of features considered to be of conservation significance and these are outlined below.

3.7.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Communities

One critically endangered community is predicted to occur within the locality: *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland*. The amended sections of the proposed pipeline route do not traverse woodland areas with the characteristic species of White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and / or Blakely's Red Gum (*E. blakelyi*) and consequently this EEC is unlikely to occur along or adjacent to the route.

Species

Predictive modelling indicates that 13 flora, 29 fauna and 18 migratory / marine species listed under the EPBC Act have the potential to occur within the locality of the GFDA and amended areas of the proposed pipeline route. Table T6, T9 and T10 of AECOM (2009) lists these species along with their habitat requirements and the likelihood of their occurrence. The amended sections of the proposed

pipeline and GFDA would provide potential habitat for 10 flora, 13 fauna and 18 migratory species which are listed under the EPBC Act (Table 1). None of the listed species were recorded within the assessed areas of amended route although several sections of the GFDA and amended pipeline have habitat which could potentially provide a number of threatened flora with suitable habitat and fauna with roosting and foraging habitat.

3.7.2 NSW *Threatened Species Conservation Act 1995*

Communities

Thirty five EECs listed under the TSC Act are known, or are predicted, to occur within the Hunter CMA sub-region and these are listed in Table T5 (AECOM 2009). Given the geographic location, soil, other ecological requirements and characteristic species of the listed EECs, it was concluded that three (Table 2) were considered to have the potential to occur along or adjacent to the amended sections of the pipeline route and GFDA. *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*, and *Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* occur within areas of clarification assessed within this report. These have been assessed in AECOM (2009) and hence are not assessed further in this report.

The only EEC which would be directly impacted by this proposal is *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions*. *Hunter Lowland Redgum Forest* is an open forest which characterises the gentle slopes of depressions and drainage flats on the Hunter Valley floor. It is characterised by the canopy tree species, Forest Red Gum and Grey Gum with other frequently occurring canopy species such as Sydney Red Gum (*Angophora costata*), Spotted Gum, Narrow-leaved Ironbark and Grey Box. The mid-storey is open and characterised by sparse shrubs such as Coffee Bush, Prickly Beard-heath (*Leucopogon juniperinus*), Gorse Bitter Pea (*Daviesia ulicifolia*) and Dogwood. The ground cover typically comprises grasses and herbs (DEC 2005a). Approximately 250 m of the amended pipeline route passes *Hunter Lowland Redgum Forest* at KP 76.3 and runs adjacent to another patch of this EEC at KP 75.7. The remnant EEC at KP 76.3 has been degraded through years of grazing resulting in the removal of the majority of native shrub and groundcover species, although mature trees remain. The remnant EEC at KP 76.7 still contains elements of an intact vegetation community with representatives from all strata present. The pipeline route has been amended to traverse the paddock area to the north of this patch of forest.

Swamp oak floodplain forest of the NSW North Coast; Sydney Basin and South East Corner Bioregions occurs adjacent to the amended pipeline route at KP 89.5 (AECOM 2009). The proposed pipeline route has been designed to avoid this patch of *Swamp oak floodplain forest* so that it passes through an open paddock to the south which is currently used for grazing of cattle.

Spotted Gum communities recorded in the Lower Hunter region of the amended pipeline route (i.e. from Clarence Town south) are likely to be representative of *Seaham Spotted Gum - Ironbark Forest* and not the EEC *Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion* as the canopy was dominated by Narrow-leaved Ironbark and the occasional Grey Ironbark rather than Broad-leaved Ironbark (*Eucalyptus fibrosa*) which is characteristic of this EEC. Furthermore, the LHCCREMS mapping (NPWS 2000) did not map *Lower Hunter Spotted Gum – Ironbark Forest* along the amended sections of the pipeline route.

Table 1 Threatened flora and fauna recorded or with the potential to occur within a 5 km buffer

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Flora				
Asperula asthenes	Trailing Woodruff	V-EPBC V-TSC ROTAP-3VC-	Grows in damp soils often along river banks.	Potential habitat.
Callistemon linearifolius	Netted Bottle Brush	V-TSC ROTAP-2RCi	Dry sclerophyll forest on the coast and adjacent ranges.	Potential habitat.
Cryptostylis hunteriana	Leafless Tongue Orchid	V-EPBC V-TSC ROTAP-3VC-	Various, including swamp-heath and woodland, mostly in coastal areas.	Potential habitat.
Eucalyptus glaucina	Slaty Red Gum	V-EPBC V-TSC ROTAP-3VCa	A medium-sized tree to 30 m tall. Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.	Potential habitat.
Grevillea guthrieana	Guthrie's Grevillea	E-EPBC E-TSC ROTAP-3V	Grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil.	Potential habitat.
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	E-TSC	Grows in heath or shrubby woodland, in sandy or light clay soils usually over shale substrates.	Recorded by AECOM 2009 near to Wallaroo National Park, Seaham.
Maundia triglochinoides		V-TSC	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Persicaria elatior	Tall Knotweed	V-EPBC V-TSC ROTAP-3V	Grows in damp sites, especially beside streams and lakes and occasionally in swamp forest.	Potential habitat.
Pomaderris queenslandica	Scant Pomaderris	E-TSC	Moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	Potential habitat.
Rhizanthella slateri	Eastern Australian Underground Orchid	V-TSC ROTAP-3KC-	Sclerophyll forest in shallow to deep loams.	Potential habitat.
Tetratheca juncea	Black-eyed Susan	V-EPBC V-TSC ROTAP-3VCa	Sandy, occasionally swampy heath and in dry sclerophyll forest; mostly in coastal districts.	Potential habitat.
Zannichellia palustris		E-TSC ROTAP-3R+	Submerged in fresh or slightly saline stationary or slowly flowing water.	Potential habitat.
Amphibians				
Litoria aurea	Green and Golden Bell Frog	V-EPBC E-TSC	Marshes, dams and stream-sides particularly those containing *Typha* or *Eleocharis*. Need waterbodies unshaded, free of predatory fish and that have a grassy area nearby.	Potential habitat.
Reptiles				
Hoplocephalus bitorquatus	Pale-headed Snake	V-TSC	Dry eucalypt forests, woodlands, cypress woodland and occasionally rainforest / moist eucalypt forest. Prefers streamside areas. During day, shelters between loose bark and tree trunks, or in hollow trunks and limbs of dead trees.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Birds				
Anseranas semipalmata	Magpie Goose	V-TSC	Wetlands usually < 1 m deep with dense growth of rushes and sedges. Wetlands associated with floodplains of rivers and large shallow wetlands formed by run off.	Potential habitat.
Botaurus poiciloptilus	Australasian Bitten	V-TSC	Emergent vegetation in freshwater and brackish wetlands. Forage in wetlands, tussocky wet paddocks and drains.	Potential habitat.
Burhinus grallarius	Bush Stone-curlew	E-TSC	Open forests and woodlands with sparse grassy ground layer and fallen timber – nocturnal, especially active on moonlit nights.	Potential habitat.
Callocephalon fimbriatum	Gang-gang Cockatoo	V-TSC	Summer - found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Winter - lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	Potential habitat.
Calyptorhynchus lathami	Glossy Black-cockatoo	V-TSC	Inhabits open forest and woodlands. Feeds on Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*).	Potential habitat.
Climacteris picumnus victoria	Brown Treecreeper (eastern subspecies)	V-TSC	Eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands, such as the	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
			Hunter Valley and Clarence Valley.	
Coracina lineata	Barred Cuckoo-shrike	V-TSC	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses.	Potential habitat.
Ephippiorhynchus asiaticus	Black-necked Stork	E-TSC	Permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	Potential habitat.
Ixobrychus flavicollis	Black Bittern	V-TSC	Forested, freshwater and saline wetlands. Breeding along watercourses.	Potential habitat.
Lathamus discolor	Swift Parrot	E-EPBC Mar-EPBC E-TSC	Migrates to the Australian SE mainland between March and October. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*). Commonly used lerp infested trees include Grey Box (*E. microcarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilularis*).	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Lophoictinia isura	Square-tailed Kite	V-TSC	Found in a variety of timbered habitats including dry woodlands and open forests especially along timbered watercourses.	Potential habitat.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V-TSC	Structurally diverse drier eucalypt woodlands, forests, scrubs with fallen timber.	Potential habitat.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern sub-species)	V-TSC	Occurs in open forests and woodlands dominated by box and ironbark eucalypts generally west of the Great Dividing Range.	Potential habitat.
Neophema pulchella	Turquoise Parrot	V-TSC	Lives on edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends majority of day on ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter.	Potential habitat.
Ninox connivens	Barking Owl	V-TSC	Breeds in HBT >20 cm diameter. Forages throughout woodlands, grassy woodlands, forests and into grasslands (250 m).	Potential habitat.
Ninox strenua	Powerful Owl	V-TSC	A range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Roosts in dense vegetation comprising species: Turpentine, Black She-oak, Blackwood, Rough-barked Apple, Cherry	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
			Ballart and a number of eucalypt species.	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V-TSC	Found in drier open forest, scrubby woodlands, road reserves, farmland and sometimes urbanised areas.	Recorded adjacent to Stage 1 GFDA extension.
Pyrrholaemus saggitatus	Speckled Warbler	V-TSC	Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies.	Potential habitat.
Rostratula benghalensis	Painted Snipe	M-EPBC Mar-EPBC V-TSC	Prefers fringes of swamps, dams and nearby marshy areas with a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation. Forages nocturnally.	Potential habitat.
Stagonopleura guttata	Diamond Firetail	V-TSC	Occurs in open eucalypt forest, mallee and acacia scrubs.	Potential habitat.
Tyto capensis	Grass Owl	V-TSC	Grass Owls are found in areas of tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.	Potential habitat.
Tyto novaehollandiae	Masked Owl	V-TSC	Lives in dry eucalypt forests and woodlands. Pair's home-range of 500 to 1000 ha. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Tyto tenebricosa	Sooty Owl	V-TSC	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation.	Potential habitat.
Xanthomyza phrygia	Regent Honeyeater	E-EPBC M-EPBC E-TSC	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak (*Casuarina cunninghamiana*). Regent Honeyeaters inhabit woodlands with a significantly high abundance of bird species. Should have large numbers of mature trees, high canopy cover and abundance of mistletoes.	Potential habitat.
Migratory and Marine Birds (solely)				
Haliaeetus leucogaster	White-bellied Sea-Eagle	M-EPBC Mar-EPBC	Found in coastal areas, on islands, estuaries, inlets, large rivers, inland lakes and reservoirs where they forage over water. Builds huge nests of sticks.	Potential habitat.
Ardea alba	Great Egret	M-EPBC Mar-EPBC	Overfly marine area. Found in shallows of rivers, estuaries, tidal mudflats, freshwater wetlands, sewage ponds, irrigation areas and larger dams.	Potential habitat.
Ardea ibis	Cattle Egret	M-EPBC Mar-EPBC	Overfly marine area. Found in stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats and drains.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Gallinago hardwickii	Latham's Snipe	M-EPBC Mar-EPBC	Summer migrant to coastal Australia where it feeds on soft wet ground or shallow water with tussocks and woodland, saltmarshes and mangrove fringes.	Potential habitat.
Arenaria interpres	Ruddy Turnstone	M-EPBC Mar-EPBC	Summer migrant to coastal Australia where it feeds on tidal reefs and pools, sandy shores or even ploughed fields.	Potential habitat.
Calidris acuminate	Sharp-tailed Sandpiper	M-EPBC Mar-EPBC	Widespread summer migrant to coastal Australia where it feeds in coastal areas and inland wetlands.	Potential habitat.
Calidris ferruginea	Curlew Sandpiper	M-EPBC Mar-EPBC	Summer migrant to coastal Australia where it can be found in coastal areas, inland, mudflats and often at saltworks.	Potential habitat.
Pluvialis fulva	Pacific Golden Plover	M-EPBC Mar-EPBC	Widespread summer migrant to coastal Australia. Found in estuaries, mudflats, saltmarshes, mangroves, rocky reefs and shallow open inland swamps, sewage ponds and paddocks.	Potential habitat.
Limosa lapponica	Bar-tailed Godwit	M-EPBC Mar-EPBC	Widespread summer migrant to coastal Australia. Found in intertidal flats and sandbanks.	Potential habitat.
Numenius madagascariensis	Eastern Curlew	M-EPBC Mar-EPBC	Common migrant to coastal areas during summer. In estuaries, tidal mudflats, sandspits, saltmarshes, mangroves and occasionally fresh or brackish lakes, bare grasslands near water.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Numenius phaeopus	Whimbrel	M-EPBC Mar-EPBC	Summer migrant to coastal Australia. Found in coastal estuaries, mudflats and mangroves.	Potential habitat.
Apus pacificus	Fork-tailed Swift	M-EPBC Mar-EPBC	Overfly marine area. Summer migrant to Australia. Overflies open country from semi-deserts to coasts and sometimes over forests and cities.	Potential habitat.
Hirundapus caudacutus	White-throated Needletail	M-EPBC Mar-EPBC	The White-throated Needletail feeds on flying insects, such as termites, ants, beetles and flies. They catch the insects in flight. Birds usually feed in rising thermal currents associated with storm fronts and bushfires and they are commonly seen moving with wind fronts.	Potential habitat.
Merops ornatus	Rainbow Bee-eater	M-EPBC Mar-EPBC	Summer breeding migrant to south-east Australia. Found in open woodlands with sandy, loamy soil, sandridges, sandpits, riverbanks, cliffs, mangroves, rainforest and woodland.	Potential habitat.
Monarcha melanopsis	Black-faced Monarch	M-EPBC Mar-EPBC	Summer breeding migrant to coastal south-eastern Australia. Found in rainforests, nearby eucalypt woodlands and mangroves.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Monarcha trivirgatus	Spectacled Monarch	M-EPBC Mar-EPBC	Summer breeding migrant to NSW coast. Prefers wet forests and mangroves mostly on outer branches of the lower canopy.	Potential habitat.
Myiagra cyanoleuca	Satin Flycatcher	M-EPBC Mar-EPBC	Summer breeding migrant to the south of its range on the south eastern Australian coast. Can be found in wetter denser forests, often at high elevations.	Potential habitat.
Rhipidura rufifrons	Rufous Fantail	M-EPBC Mar-EPBC	Breeding migrant to south-eastern Australia during July to December. Prefers wetter eucalypt forests, gullies, coastal scrub, watercourses and rainforests where it feeds on insects.	Potential habitat.
Mammals				
Cercartetus nanus	Eastern Pygmy-possum	V-TSC	Rainforest, sclerophyll forest and woodland to heath – but heath and woodland preferred. Forages on banksias, eucalypts and bottlebrushes.	Potential habitat.
Chalinolobus dwyeri	Large-eared Pied Bat	V-EPBC V-TSC	Roosts - caves (near their entrances), crevices in cliffs, derelict mines and in the disused, bottle-shaped mud nests of the Fairy Martin frequenting low to mid-elevation dry open forest and woodland close to these features.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Dasyurus maculatus	Spotted-tailed Quoll	E-EPBC V -TSC	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects; also eats carrion and takes domestic fowl.	Potential habitat.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V-TSC	Prefers moist habitats with trees >20 m. Roosts in HBT or under bark or in buildings.	Potential habitat.
Macropus parma	Parma Wallaby	V-TSC	Moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	Potential habitat.
Miniopterus australis	Little Bentwing-bat	V-TSC	Found in well timbered areas including rainforest, wet and dry sclerophyll forests, melalecua swamps and coastal forests. Roosts in caves.	Potential habitat.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V-TSC	Roosting – caves, derelict mines, stormwater tunnels, buildings. Forages over and within forested areas.	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
Mormopterus norfolkensis	Eastern Freetail-bat	V-TSC	Dry sclerophyll forest and woodland. Roosts - hollows and under bark or man-made structures.	Potential habitat.
Myotis macropus	Large-footed Myotis	V-TSC	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, HBTs, stormwater channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish by raking their feet across the water surface.	Potential habitat.
Petaurus australis	Yellow-bellied Glider	V-TSC	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soil.	Potential habitat.
Petaurus norfolcensis	Squirrel Glider	V-TSC	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or *Acacia* midstorey. Require abundant tree hollows for refuge and nest sites.	Potential habitat.
Phascogale tapoatafa	Brush-tailed Phascogale	V-TSC	Dry sclerophyll open forest with sparse groundcover. Also heath, swamps, rainforest and wet sclerophyll forest.	Potential habitat.
Phascolarctos cinereus	Koala	V-TSC	Eucalypt woodlands and forests. Has preferred feed tree species.	Potential habitat.
Potorous tridactylus	Long-nosed Potoroo	V - EPBC V – TSC	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an	Potential habitat.

Scientific Name	Common Name	Conservation Rating	Habitat Requirements	Recorded in buffer or potential habitat
			essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of Tea-trees or *Melaleucas*. A sandy loam soil is also a common feature.	
Pteropus poliocephalus	Grey-headed Flying-fox	V-EPBC V-TSC	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps.	Potential habitat.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V-TSC	Roosts singly or in groups of up to six, in HBTs and buildings. Will use mammal burrows. Forages in most habitats across areas with and without trees. Appears to defend an aerial territory.	Potential habitat.
Scoteanax rueppellii	Greater Broad-nosed Bat	V-TSC	Woodland, moist and dry eucalypt forest and rainforest but prefers tall wet forest. Roosts - tree hollows but also buildings.	Potential habitat.

Note*:* TSC Act = *Threatened Species Conservation Act 1995*; EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*, V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory, Mar = Marine; HBT = Hollow-bearing tree. **Source**: Botanic Gardens Trust 2009, DEC 2005a, NPWS 1999; Simpson and Day 2004.

Table 2 EECs listed under the TSC Act which occur or have the potential to occur along amended areas of the GFDA and pipeline route.

Vegetation Community	Conservation Status	Preferred Habitat	Likely Occurrence Along Pipeline Route
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	EEC	Open forest on gentle slopes of depressions and drainage flats on the Hunter Valley floor. The most common canopy tree species are Forest Red Gum and Grey Gum and subdominants of Smooth-barked Apple, Spotted Gum, Narrow-leaved Ironbark and Grey Box. The mid-storey is characterised by sparse shrubs such as *Breynia oblongifolia, Leucopogon juniperinus, Daviesia ulicifolia* and *Jacksonia scoparia* with ground cover typically grasses and herbs.	Recorded along and adjacent to the amended pipeline route between approximately KP 75.7 and 76.2.
Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion	EEC	Open forest dominated by Spotted Gum and Broad-leaved Ironbark with occasional Grey Gum and Narrow-leaved Ironbark. Understorey comprises tall shrubs and the understorey is diverse.	Unlikely. Spotted Gum communities likely to be representative of Seaham Spotted Gum Ironbark Forest due to species composition.
Swamp oak floodplain forest of the NSW North Coast; Sydney Basin and South East Corner bioregions	EEC	This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *S*wamp Oak is the dominant species northwards from Bermagui.	Recorded adjacent to the amended pipeline route at KP 90.5.
Note: TSC Act = *Threatened Species Conservation Act 1995*, EEC = endangered ecological community. **Source**: DEC 2005a, Botanic Gardens Trust 2009, NPWS 1999.			

Populations

There are nine endangered populations listed under the TSC Act that have been recorded within the wider study area around the GFDA and amended pipeline route (Table T4 AECOM 2009). The amended GFDA and pipeline route provide potential habitat for two populations (Table 3).

Table 3 Endangered Populations (TSC Act) with the potential to occur within the amended area

Endangered Population	Description
Cymbidium canaliculatum population in the Hunter Catchment	Large epiphytic orchid commonly occurring within *Eucalyptus albens* woodland typically in a single clump between 2 and 6 m above ground level. Less commonly found on *E. dawsonii, E. crebra, E. moluccana, Angophora floribunda, Acacia salicina*. Narrow-leaved Ironbark (*E. crebra*) and Grey Box (*E. moluccana*) were recorded along the amended sections of the pipeline route. Potential habitat predominantly north of KP 76.
Rhizanthella slateri population in the Great Lakes LGA	The Eastern Australian Underground Orchid is known to occur in sclerophyll forest. The population in the Great Lakes local government area (LGA) occurs at the known northern limit of the species' range and is disjunct from other known populations of the species. The dominant vegetation type within the amended areas is sclerophyll forest and consequently there is potential for this species to occur in these areas. Potential habitat predominantly north of KP 76.
Note*:* TSC Act = *Threatened Species Conservation Act 1995.* **Source**: DEC 2005a, Botanic Gardens Trust 2009, NPWS 2000	

Species

There have been 19 flora and 69 fauna species listed under the TSC Act recorded within the locality (i.e. 5 km buffer). Table T6, T9 and T10 of AECOM (2009) lists these species along with their habitat requirements and the likelihood of their occurrence. Those species with the potential to occur along the amended sections of the pipeline and GFDA are listed in Table 1, and these include 12 flora and 43 fauna species. None of the flora and only one of the fauna species was recorded during this study. The Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) which is listed as vulnerable under the TSC Act was recorded (Figure 2) within a wooded area adjacent to the gathering lines of the proposed south-eastern most well in the GFDA and it is likely that this species would occur along the access tracks and adjacent woodlands of several of the other well sites.

The majority of the amended GFDA and pipeline route traverses modified habitats which are unlikely to provide high quality flora and fauna habitat suitable for the majority of threatened species unless the species are highly mobile. However, there are a number of sections of pipeline which traverse vegetated areas, including KP 18.5 to 20 and KP 71.5 to 73.5 and KP 76 and KP 92.3 to 95 which encompasses the Hunter River and SEPP 14 wetlands at Tomago (SEPP 14 Wetland No. 830 and

831), and there are large tracts of intact vegetation nearby allowing mobile species from larger stands of intact vegetation to use neighbouring areas of lesser habitat value from time to time.

3.7.3 RoTAP Species

Seventy two *Rare or Threatened Australian Plants* (RoTAP) are listed as occurring within the Gloucester, Dungog, Great Lakes, Port Stephens and Newcastle LGAs (Botanic Gardens Trust 2009). None of these species were recorded along the amended pipeline route or within amended GFDA area. All of these species are also listed as threatened under the TSC Act and hence those species for which habitat occurs have been considered under the TSC Act (Table 1).

3.7.4 Declared Noxious Weeds

In NSW the identification, classification and control of noxious weeds is governed by the *Noxious Weeds Act 1993* (NW Act). Plants that have been declared as noxious weeds are classified into specific control classes in each Local Control Area. Those plants listed as Noxious Weeds for the six local government areas covered by this project and that were found along the pipeline route are listed in Table 4

Table 4 Noxious weeds recorded along the proposed pipeline route

Botanic Name	Common Name	Noxious Weed Control Class
Sporobolus fertilis	Giant Parramatta Grass	3
Lantana camara	Lantana	5
Cortaderia selloana	Pampas Grass	4
Nassella trichotoma	Serrated Tussock	3
Rubus fruiticosus	Blackberry	4
Salix babylonica	Weeping Willow	5
Ligustrum lucidum	Large Leaved Privet	4
Ligustrum sinense	Small Leaved Privet	4
Source: DPI 2009		

The control requirements for each of these classes are:

- **Class 3 - Regionally Controlled Weeds**: Plants that pose a serious threat to primary production or the environment of an area to which the order applies, and are likely to spread in the area or to another area. Legal requirements are that the plant must be fully and continuously suppressed and destroyed.
- **Class 4 - Locally Controlled Weeds**: Plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies

and are likely to spread in the area or to another area. Legal requirements are that the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local authority.

- **Class 5 - Restricted Plants**: Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State. Legal requirements are that the requirements in the NW Act for a notifiable weed must be complied with.

Blackberry is also listed as a Weed of National Significance (Weeds in Australia 2009) and the plans and controls associated with this listing should also be implemented for control of this weed.

3.7.5 Corridors and Connectivity

The amended sections of the pipeline predominantly traverse cleared agricultural paddocks. However, from approximately KP 18 to 20 and KP 71.5 to 73.5 the pipeline route traverses the edge of remnant or regrowth vegetation and sometimes along powerline easements. The northern end of the pipeline traverses a patch of vegetation that would provide east – west stepping stone habitat for mobile and dispersing fauna and flora. Although densely vegetated links do not occur, scattered paddock trees and riparian vegetation along Karuah River, Mammy Johnsons River, creeks and other drainage lines would provide loose but adequate connections for some species between densely vegetated areas within Buckleys Range, Copper Mine Ridge and vegetation beyond. The mid section of the amended pipeline route traverses the western edge of a powerline easement which is connected to well vegetated areas to the west. Areas to the south are cleared and only minor connections would remain along riparian areas.

3.7.6 *State Environmental Planning Policy 44 - Koala Habitat Protection*

Muswellbrook and Singleton are listed as local government areas subject to the provisions of *State Environmental Planning Policy 44 - Koala Habitat Protection* (SEPP 44). A number of Koala records are known from the locality and occur close to the proposed amended pipeline route. Two species of Koala feed trees listed on Schedule 2 of SEPP 44, (i.e. Forest Red Gum (*Eucalyptus tereticornis*) and Grey Gum (*Eucalyptus punctata*) were recorded along the pipeline route. For an area to be considered as potential Core Koala Habitat, Schedule 2 tree species must occur at densities greater than 15%. Although no formal assessment was undertaken it is unlikely that Grey Gum occurs at densities greater 15%. However, it is likely that Forest Red Gum occurs at greater than 15% in the remnant patches of *Hunter Lowland Redgum Forest* from approximately KP 75.7 and 76.2 and this area could be considered to be potential core habitat for Koalas.

The proposed pipeline route traverses the Western Management Unit of the *Port Stephens Council CKPoM* (Port Stephens Council 2002) and Koala habitat has been mapped for this assessment area:

- Both *Hunter Lowland Redgum Forest* remnant patches at KP 75.7 and 76.2 are mapped as 'Marginal Koala Habitat';
- Deadmans Creek, which is located at KP 74.4 and approximately 1 km east of the most northern *Hunter Lowland Redgum Forest,* has been mapped as 'Preferred Koala Habitat' with buffers; and

- The area between the *Hunter Lowland Redgum Forest* and Deadmans Creek as 'Link over Cleared Koala Habitat'.

Preferred Koala Habitat is the most important category of Koala habitat in the Port Stephens LGA and hence should be afforded the highest level of protection. Marginal Koala Habitat is all forested areas which are neither Preferred nor Supplementary Koala Habitat. Linking habitat provides habitat for movement and dispersal of Koalas and potential areas for restoration.

Deadmans Creek will be underbored by HDD to avoid the mapped 'Preferred Koala Habitat'.

3.7.7 State Environmental Planning Policy 14 – Coastal Wetlands

The *State Environmental Planning Policy 14 – Coastal Wetlands* (SEPP 14) seeks to control development within Coastal Wetland areas for environmental and economic considerations. SEPP 14 Wetlands 830 and 831 occur at the southern end of the amended route at Tomago. Thrust boring will be used to pass under Wetland 831 and horizontal directional drilling will be used to pass under sections of Wetland 830 but also adjacent to this wetland along a section of Old Punt Road.

These two SEPP 14 wetlands have the potential to be indirectly impacted by the proposed pipeline if management measures are not implemented. SEPP 14 wetlands should not be cleared, drained or filled without consent and any development within or near listed wetlands must be considered for the impact it might have on the environment, and whether or not the development is avoidable within these areas, before consent is granted.

4 IMPACT ASSESSMENT

The route of the amended proposed pipeline and the Stage 1 GFDA extension have in general been designed to either avoid areas of conservation significance or, where these could not be avoided, HDD has been proposed to mitigate against impacts associated with traditional trenching techniques. Nonetheless, there is the potential for a number of impacts as a consequence of construction and operation of this pipeline and these are discussed below.

4.1 Construction and Operational Disturbances

Table 5 outlines the major disturbances to terrestrial ecosystems that are likely to occur within the Stage 1 GFDA extension and along the amended pipeline route. Clearing of a 25 – 30 m right-of-way (ROW) would be undertaken along the majority of the amended pipeline route but this could be reduced to 15 m to lessen impacts to ecologically sensitive receptors such as intact bushland and creek crossings.

Table 5 Terrestrial disturbances associated with the proposal

Proposal Stage	Disturbance
Stage 1 GFDA Extension	
Site preparation	Clearance of existing groundcover and topsoil (to be stored for site rehabilitation).
	Import of gravel and erection of site fence around an area of up to 90 m x 90 m with a gravel hardstand of 65 x 65 m.
Preparation of access tracks and string line areas	Grading and improvement of access tracks for heavy vehicle access, maximum 4 m disturbance width.
Borehole drilling	Movement of vehicles to and from the established drill pad.
	Operational noise of drill rig and associated activities.
Amended Pipeline Route	
Site preparation	Clearance of vegetation for a width of 2 5 - 30 m with cleared vegetation stockpiled on the non-working side of the ROW. Width of ROW would be reduced in areas of significant conservation value.
	Removal of topsoil to a depth of 100 to 150 mm to be stockpiled adjacent to the cleared vegetation on the non-working side of the ROW.
Preparation of access tracks	Grading and improvement of access tracks for heavy vehicle access, maximum 4 m disturbance width.

Proposal Stage	Disturbance
Digging of trench	A trench would be dug to a depth of 750 mm to the top of trench. With subsoil stockpiled separate to topsoil in the non-working side of the ROW.
	Operational noise of trenching and other machinery and associated activities.
Additional working and lay down areas	AECOM (2009) recommend the following measures to minimise clearing of native vegetation required for construction purposes, including lay down areas. Adoption of the following locational principles to locate envelopes for gas wells, flowlines and CPF include: ▪ not within 100 m of existing residences or as required to meet project noise goals; ▪ minimum of 40 m from a watercourse; ▪ avoiding native vegetation (about 6% of GFDA) and riparian areas; ▪ avoiding Indigenous and European heritage places or items; ▪ located adjacent to existing fence lines and access tracks where possible; ▪ located on relatively flat ground (i.e. less than 10% gradient); ▪ considering visual effects and opportunistic use of natural screening such as vegetation; and ▪ considering land use and landowner preferences.
Note: ROW = right-of-way	

Construction activity will be confined to the pipeline route and adjoining land to which access is available for construction purposes. The pipeline requires a construction ROW of approximately 25 - 30 m wide plus temporary work space within the 100 m wide assessment corridor. Temporary extra work space will be required in areas such as watercourses (refer above table). The temporary work space will be leased for the duration of the construction phases of the project. Although a 25 – 30 m construction ROW is required for the majority of the pipeline length, it is intended wherever possible to confine the high disturbance zone to a 15 m width for trenching, brush and spoil storage and vehicle movement in sensitive areas

4.1.1 Watercourse Crossings

Various methods for crossing watercourses are available depending on the sensitivity of the watercourse to be crossed. The least sensitive watercourses may be crossed using open trenching techniques, watercourses with larger water flows may be crossed using open trenching with stream flow diversions and sensitive watercourses may be crossed using HDD techniques. AECOM (2009) provides a description of each method and a summary is provided below.

Open Trench - Watercourse Crossings

Open trenching would be applied in dry or shallow low flow watercourses. This method involves standard trenching techniques using an excavator or backhoe, ensuring the watercourse bed and bank material and trench spoil would be stockpiled separately, clear of the watercourse channel. A prefabricated pipe would subsequently be placed across the watercourse, lowered and the trench immediately backfilled.

Open Trench with Stream Flow Diversion

Stream flow diversion techniques are used as a modification to the standard open trenching and are utilised where higher water volumes and flows are present (typically for flows up to 1000 L/s). This technique involves in-stream trenching and pipe laying undertaken within a temporarily dewatered section of the watercourse using temporary dams. Water flow would be maintained by pumping the water around the dewatered section of the watercourse or through the installation of a bypass flume. Temporary dams can be formed by a number of methods such as sheet piling, sandbags or water filled dams (e.g. AquadamTM). Dewatering may be required at the crossing area, and strategically located sumps may allow this to occur. Prefabricated pipes would be installed similarly as for open trench crossings, the trench backfilled with appropriate coating protection if required, followed by controlled removal of the downstream dam and subsequent removal of the upstream dam.

Thrust Boring

Thrust boring may be used for some watercourse crossings. Thrust boring involves drilling from below ground within an enlarged trench area, known as a bell hole, located on either side of the area to be bored. The bell hole in which the thrust bore rig operates is typically 25 m or more long and 4 – 5 m wide to allow for the thrust bore rig in addition to a full length of pipe. The receiving bell hole is typically 4-5 m long and 3 m wide.

Horizontal Directional Drilling (HDD)

HDD may be used to cross major watercourses or at sites where open cut methods are not suitable. This method involves drilling a hole at a shallow angle beneath the surface, then pulling the welded pipe string back through the drill hole. Excavation of a cuttings settlement pit and a mud pit may be required at each of the entry and exit points. Once the pipe string is installed and connected to the main sections of the pipeline, the entry and exit points would be remediated and excess material would be disposed of at a licensed waste facility. HDD requires the use of a specialist drill rig, equipment and operator which may vary in size depending on the length of the HDD and the site geology. Smaller HDD rigs may be self-contained (e.g. on the back of a semi-trailer) while larger HDD rigs may require a designated pad.

4.2 Direct Impacts

There are a number of direct impacts predicted to occur within the Stage 1 GFDA extension area and amended pipeline routes and these are discussed below.

The Stage 1 GFDA extension is characterised by cleared land which has been used for agriculture over a number of years. Well sites within the GFDA would be located so as to avoid the removal of remnant vegetation and paddock trees and consequently clearing would be confined to paddock areas.

Construction activities associated with the pipeline will be confined to the pipeline route and adjoining land to which access is available for construction purposes. The pipeline requires a construction ROW of approximately 25 - 30 m plus temporary work spaces within the 100 m wide assessment corridor. The anticipated vegetation removal along the length of the pipeline is shown in Table 6. The expected clearing along the length of the overall pipeline route is contained in *Appendix G Explanatory Note* of the overall Environmental Assessment Report.

Table 6 Vegetation clearance along the amended sections of the pipeline route

Vegetation Community	Direct Impacts
Introduced pastures	25 - 30 m ROW along the majority of the proposed pipeline route.
Spotted Gum – Ironbark Forest Between KPs 17.8 – 18, 18.5 – 18.9, 19.2 – 19.4, 19.6 – 20, 23 – 23.2, 24.2 – 24.4	Totalling 1.51 ha
Grey Gum – Stringybark - Bloodwood ± Spotted Gum Ironbark Forest Between KPs 71.5 – 71.7, 71.8 – 72.5, 72.6 – 73.4	Totalling 2.24 ha
Hunter Lowland Redgum Forest (EEC) Between KP 75.7 – 76.2	Totalling 0.23 ha
Riparian communities Ramstation Creek (KP 28.8) HDD - Deadmans Creek (KP 74.4)	 0.08 ha (reduced ROW of 10 m) No clearing of intact riparian communities at Deadmans Creek.
SEPP 14 Wetlands 830 and 831	No clearing (HDD – under both wetlands)
Wetlands	No clearing (HDD or under bore)
Note: ROW = right-of-way	

Paddock trees would be avoided where possible. Drainage line crossings have been directed to areas either lacking native vegetation or areas of less substantial vegetation with the aim of avoiding large trees wherever possible.

4.2.1 Loss of Fauna Habitat

The majority of fauna habitat which would be removed within the Stage 1 GFDA extension area and along the amended pipeline route is that provided by introduced pasturelands. This may temporarily affect species such as the Eastern Grey Kangaroo and Common Wombat (*Vombatus ursinus*), both of which are common in this area. This is unlikely to have a long term impact on these species as the trench would be backfilled almost simultaneously with laying of the pipe and so movement for foraging and dispersal throughout the area would not be restricted in the long term.

Wherever possible paddock trees would be avoided as would substantial vegetation within drainage lines thereby ensuring that as many trees as possible with hollows are retained. It is unlikely that amphibian habitat would be substantially disturbed as the majority of drainage lines traversed by the pipeline are ephemeral and they lack native vegetation. Farm dams would not be impacted by this proposal.

Some fauna habitat would be removed with the clearance of 1.51 ha *Spotted Gum – Ironbark Forest* and 2.24 ha *Grey Gum – Stringybark - Bloodwood* ± *Spotted Gum Ironbark Forest* and 0.23 ha *Forest Red Gum – Spotted Gum Woodland*. This habitat primarily occurs along edges of previously cleared areas such as paddocks and powerline easements. Nonetheless, fauna resources in the form of foraging and nesting habitat for a range of arboreal and ground dwelling mammals, woodland birds and reptiles would be lost and already cleared corridors would experience additional widening which may increase habitat fragmentation.

4.2.2 Impacts on aquatic habitats

Some changes to hydrological regimes along the pipeline route have the potential to occur. Changes to hydrological processes can have a number of potential effects including:

- Alteration of the ecology of an area including the vegetational composition and loss of fauna habitat;
- Increased run off rates and hence erosion;
- Changes in soil moisture content; and
- Creation of conditions conducive to invasion by exotic species.

Impacts on aquatic habitats are likely to be spatially and temporally limited. HDD would be used to pass under creek crossings which are considered to contain areas of intact and substantial vegetation and significant aquatic and estuarine environments, including:

- Hunter River North Arm at KP 92.3 and again at KP 94.5; and
- Deadmans Creek – KP 74.4.

Compounds housing the drill rig and associated infrastructure would also be placed well clear of the riparian zones (at least 40 m) further reducing potential impacts.

The more minor crossings including dry or low flow creeks and ephemeral drainage lines, would be trenched at locations which do not require removal of substantial native vegetation or emergent aquatic vegetation. This would be achievable as the drainage lines and creeks are largely highly eroded, weed infested and ephemeral in nature. To ensure that water quality is not further impacted through erosion and sedimentation, measures such as silt curtains, would be used to control impacts. The trench would be backfilled once the pipeline is laid and hence any disruption to flow or fauna movement would be temporally limited. If it is necessary to upgrade any drainage line or creek crossings along access tracks to allow truck movements during construction of the pipeline it is recommended that box culverts be used in accordance with the guidelines for requirements for waterway crossings (Fairfull and Witheridge 2003).

4.2.3 Impacts on SEPP 14 Coastal Wetlands

Potential impacts on the SEPP 14 Wetlands No. 830 and 831 at Tomago could include:

- Changes to the hydrological regime and / or water quality of the wetlands;
- Changes to the saltmarsh / mangrove associations within the wetlands and downstream;
- Effects on the habitat or lifecycle of native species dependent upon the wetland; and
- Invasion and establishment of non-native flora and fauna species in the wetland.

Direct impacts on SEPP 14 Wetlands No. 830 and 831 at Tomago are not expected as these areas would be avoided through the use of HDD. The drilling would start back from the northern bank of the Hunter River at KP 92.1, pass under the Hunter River and under the Tomago wetlands until KP 93.6 where it would be open trenched along the margins of the caravan park to Old Punt Road and then along Old Punt Road within a cleared road reserve. The pipeline would then continue by HDD from Fogacs Engineering Pty Ltd carpark, under the Hunter River at KP 94.5 and exit back from the southern bank of the Hunter River.

4.3 Indirect Impacts

Indirect impacts on biodiversity during construction and operation are possible and these are discussed below.

4.3.1 Changes to Water Quality

Potential impacts during and following construction on water quality in drainage lines, down slope areas and farm dams are possible, from run-off and sedimentation through earthworks and the removal of vegetation. Measures to prevent stormwater runoff and sedimentation from entering waterways would be required and these may include silt curtains, or isolation construction using dam

and pump or flume pipe techniques. A Construction Environmental Management Plan (CEMP) including a Sediment and Erosion Control Plan should be prepared prior to construction. Provided appropriate stormwater and sediment trapping systems are implemented and that revegetation of the area is undertaken as soon as is practical after construction, then indirect impacts are not anticipated. However, it is also recommended that if possible, works be undertaken during the drier months of the year, i.e. June to September.

4.3.2 Edge Effects

Clearance of vegetation and the maintenance of a track for vehicular access along the length of the pipeline route have the potential to increase edge effects. Edge effects include the increased likelihood of weed establishment, changes in microclimates along the edges of vegetation communities and facilitate movement of feral animals (e.g. European Red Fox (*Vulpes vulpes*)) through an area. The pipeline route in general is an area that has undergone clearing and fragmentation over time, thereby gradually increasing edge effects. Clearing of these areas would It is unlikely that this proposal would substantially increase the existing edge effects.

4.3.3 Disturbance of fauna

Disturbance of fauna during construction could occur through an increase in noise and activity levels across the site, including increased traffic. Disturbance of fauna can result in changes to the behaviour and patterns of resource use by certain fauna species. The outcome of which may be increases in roadkill, which could include death or injury to threatened species including the Grey-crowned Babbler. Ways to avoid increased strike rate of the Grey-crowned Babbler should be included in the CEMP.

4.3.4 Hunter Estuary National Park

The Tomago Wetlands and the Hunter River north arm are upstream of the Hunter Estuary National Park which is formed partly by Kooragang Island, Hunter Estuary, Hexham Swam and Ash Island, an area which is internationally recognised for its migratory bird habitat. Indirect impacts could potentially affect this national park through changes in water quality as a consequence of the effects of sedimentation and disturbance of acid sulphate soils, resulting in fewer feeding resources. Stringent management measures should be incorporated into the CEMP and OEMP to avoid indirect impacts to these sensitive receptors.

4.4 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

An assessment of the impacts of the proposal on ecological communities, populations and species listed under the EPBC Act has been undertaken using the Significant Impact Criteria detailed in the *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines: Matters of National Environmental Significance* (DEH 2006). Details of this assessment are contained in Appendix B and the outcomes briefly outlined below.

Species assessed included:

- Trailing Woodruff (*Asperula asthenes*);
- Leafless Tongue Orchid (Cryptostylis hunteriana);

- Slaty Red Gum (*Eucalyptus glaucina*);
- Guthrie's Grevillea (*Grevillea guthrieana);*
- *Tall Knotweed (Persicaria elatior*);
- Eastern Australian Underground Orchid (*Rhizanthella slateri);*
- Black-eyed Susan *(Tetratheca juncea);*
- Green and Golden Bell Frog (*Litoria aurea*);
- Regent Honeyeater (*Xanthomyza phrygia*);
- Swift Parrot (*Lathamus discolor*);
- Painted Snipe (*Rostratula benghalensis*);
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*);
- Long-nosed Potoroo (*Potorous tridactylus tridactylusis)*;
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Painted Snipe (*Rostratula benghalensis*);
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*);
- Great Egret (*Ardea alba*);
- Cattle Egret (Ardea ibis);
- Latham's Snipe (*Gallinago hardwickii*);
- Ruddy Turnstone (*Arenaria interpres*);
- Sharp-tailed Sandpiper (*Calidris acuminate*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Pacific Golden Plover (*Pluvialis fulva*);
- Bar-tailed Godwit (*Limosa lapponica*);
- Eastern Curlew (*Numenius madagascariensis*);
- Whimbrel (*Numenius phaeopus*);
- Fork-tailed Swift (*Apus pacificus*);
- White-throated Needletail (*Hirundapus caudacutus*);
- Rainbow Bee-eater (*Merops ornatus*);
- Black-faced Monarch (*Monarcha melanopsis*);
- Spectacled Monarch (*Monarcha trivirgatus*);
- Satin Flycatcher (*Myiagra cyanoleuca*); and
- Rufous Fantail (*Rhipidura rufifrons*).

It was concluded that with the implementation of stringent mitigation measures and environmental management, that the Stage 1 GFDA extension and the amended sections of the pipeline route would be unlikely to significantly impact any species, population or habitat along the pipeline route and within the locality as:

- In general, the proposed pipeline route has been located so as to avoid areas of high biodiversity which would be most likely to provide habitat to listed species and endangered ecological communities;
- In unavoidable areas of high conservation status, (e.g. SEPP 14 Wetlands, Hunter River Estuary, substantial riparian areas), HDD techniques would be undertaken to avoid direct impacts on these areas; and
- Potential impacts could be managed and mitigated with stringent environmental management.

4.5 NSW *Environmental Planning and Assessment Act 1979*

An assessment of the impacts of this proposal on species, populations and ecological communities listed under Schedules 1, 1A and 2 of the TSC Act was undertaken in accordance with the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007). In accordance with a specific request from the Department of Planning, Assessments of Significance were undertaken for endangered ecological communities and populations, and threatened species. Details of this assessment are contained in Appendix C and the outcomes briefly outlined below.

The species, populations and ecological communities addressed included:

Endangered Ecological Communities

- *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions*; and
- *Swamp oak floodplain forest of the NSW North Coast; Sydney Basin and South East Corner bioregions*.

Endangered Populations

- *Cymbidium canaliculatum* population in the Hunter Catchment; and
- *Rhizanthella slateri* population in the Great Lakes LGA.

Flora

- Trailing Woodruff (*Asperula asthenes*);
- Netted Bottle Brush (*Callistemon linearifolius);*
- Leafless Tongue Orchid (Cryptostylis hunteriana);
- Slaty Red Gum (*Eucalyptus glaucina*);
- Guthrie's Grevillea (*Grevillea guthrieana*);
- Small-flower Grevillea (*Grevillea parviflora* subsp*. parviflora*);
- *Maundia triglochinoides;*
- Tall Knotweed *(Persicaria elatior*);
- Scant Pomaderris (*Pomaderris queenslandica);*
- Eastern Australian Underground Orchid (*Rhizanthella slateri);*
- Black-eyed Susan *(Tetratheca juncea);* and
- *Zannichellia palustris.*

Amphibian

- Green and Golden Bell Frog (*Litoria aurea*).

Reptile

- Pale-headed Snake (*Hoplocephalus bitorquatus*).

Water-dependent Birds

- Magpie Goose (*Anseranas semipalmata*);
- Australasian Bittern (*Botaurus poiciloptilus*);
- Black-necked Stork (*Ephippiorhynchus asiaticus*);
- Black Bittern (*Ixobrychus flavicollis*); and
- Painted Snipe (*Rostratula benghalensis*).

Woodland Birds

- Bush Stone-curlew (*Burhinus grallarius);*
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoria*);
- Barred Cuckoo-shrike (*Coracina lineata*);
- Swift Parrot (*Lathamus discolor*);
- Square-tailed Kite (*Lophoictinia isura*);
- Hooded Robin (*Melanodryas cucullata*);
- Black-chinned Honeyeater (*Melithreptus gularis gularis)*;
- Turquoise Parrot (*Neophema pulchella*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis)*;
- Speckled Warbler (*Pyrrholaemus saggitatus);*
- Diamond Firetail (*Stagonopleura guttata*);
- Regent Honeyeater (*Xanthomyza phrygia*); and
- Glossy Black-cockatoo (*Calyptorhynchus lathami*).

Owls

- Grass Owl (*Tyto capensis*);
- Barking Owl (*Ninox connivens*);
- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*); and
- Sooty Owl (*Tyto tenebricosa*).

Arboreal Mammals

- Squirrel Glider (*Petaurus norfolcensis*);
- Eastern Pygmy-possum (*Cercartetus nanus*);
- Yellow-bellied Glider (*Petaurus australis*); and
- Koala (*Phascolarctos cinereus*).

Ground-dwelling Mammals

- Parma Wallaby (*Macropus parma*);
- Long-nosed Potoroo (*Potorous tridactylus tridactylus*);
- Brush-tailed Phascogale (*Phascogale tapoatafa*); and
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*).

Microchiropteran Bats

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Little Bentwing-bat (*Miniopterus australis);*
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Large-footed Myotis (*Myotis macropus*);
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii);* and
- Large-eared Pied Bat (*Chalinolobus dwyeri)*.

Megachiropteran Bat

- Grey-headed Flying-fox (*Pteropus poliocephalus*).

Conclusion

It was concluded that with the implementation of stringent mitigation measures and environmental management the proposal would be unlikely to significantly impact any species, population or habitat along the amended sections of the pipeline route and within the locality as:

- In general, the proposed pipeline route has been located so as to avoid areas of high biodiversity which would be most likely to provide habitat to listed species and endangered ecological communities;
- In unavoidable areas of high conservation status, HDD techniques would be used to avoid direct impacts on these areas; and
- Potential impacts could be managed and mitigated with stringent environmental management.

4.6 Threatening Processes

Key threatening processes (KTP) listed under the TSC Act / EPBC Act which may be relevant to this proposal include:

4.6.1 Clearing of native vegetation / land clearance

The clearing of native vegetation may result in:

- Destruction of habitat causing a loss of biological diversity, and may result in total extinction of species or loss of local genotypes;

- Fragmentation of populations resulting in limited gene flow between small isolated populations, reduced potential to adapt to environmental change and loss or severe modification of the interactions between species;
- Riparian zone degradation, such as bank erosion leading to sedimentation that affects aquatic communities;
- Disturbed habitat which may permit the establishment and spread of exotic species which may displace native species; and
- Loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates.

The nature of the proposal is unlikely to result in total extinction of species or loss of local genotypes as the area to be cleared is a relatively narrow strip of agricultural paddocks and 4.78 ha of native vegetation along 26 km of amended pipeline which is unlikely to provide the only important habitat for a species or to impede gene flow through this area even for small isolated populations. Major waterways, or creeks with substantial vegetation, would be under bored while more minor creeks and drainage lines would be trenched in areas that lack native vegetation. A CEMP would be prepared and this would address measures to avoid further erosion and sedimentation. Although the majority of the amended sections of the pipeline route are weed infested, the native woodland areas being traversed by the amended sections of the pipeline route are relatively weed free in sections and these should be monitored to ensure that weed species do not become established along the ROW.

4.6.2 Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands

Riparian zone degradation may occur where changes to flows increases erosion, leading to sedimentation impacts on aquatic communities. This proposal would not result in long term changes to flows as works associated with trenching would be temporary and the banks would be reinstated to ensure that further erosion and degradation does not occur. Measures to prevent erosion and sedimentation would be detailed in the CEMP which would be prepared before commencement of the works.

4.6.3 Predation by the European Red Fox

It is possible that this proposal may result in increased predation by the European Red Fox. A track would be maintained along the length of the pipeline route which would allow increased movement of this species as the European Red Fox prefers to move through landscapes along tracks and along edges of habitat. Considering the extent of the current modification of this landscape it is unlikely that this proposal would substantially exacerbate this KTP.

4.7 Impacts on SEPP 14 Coastal Wetlands

Direct impacts on SEPP 14 Wetlands No. 830 and 831 at Tomago are not expected as these areas would be avoided through HDD beginning back from the northern bank of the Hunter River at KP 92.1, under the Hunter River and under the Tomago Wetlands until KP 93.6 where it would be open trenched along the margins of the caravan park to Old Punt Road and then along Old Punt Road within a cleared road reserve. The pipeline would then continue by HDD from Fogacs Engineering Pty Ltd carpark, under the Hunter River at KP 94.5 before exiting back from the southern bank of the Hunter River in a disused industrial site.

4.8 Corridors and Connectivity

Linear structures can cause disruptions to movement corridors as some fauna and the propagules of some plants are unable to move across areas which are cleared and / or have barriers that physically hinder movement. This can create isolation and fragmentation of landscapes.

However, it is unlikely that the amended sections of the pipeline route would substantially disrupt large scale corridors and fragment connectivity as the proposed route generally traverses introduced pastures and the ROW required for construction is narrow (i.e. 30 m). It may marginally disrupt fine scale movement corridors for less mobile species but this would largely be over a very short time frame as backfilling of the trench would take place directly after laying the pipe.

4.9 Cumulative Impacts

Construction of the proposed pipeline route is not likely to substantially increase cumulative impacts. The route selected for the proposed pipeline is predominately through pastures and only relatively small amounts of native vegetation would be removed and these are along the edges of existing tracks and roads. Therefore, it is considered that the scale of the impact of the proposed route is small and impacts associated with construction and operation are predicted to be relatively minor and manageable.

5 MITIGATION RECOMMENDATIONS

The current overall condition and biodiversity along the amended sections of the pipeline route could be protected and maintained by implementing a range of management measures to mitigate and ameliorate any potential impacts and these should be incorporated into management plans and rehabilitation plans for the site. Central to these measures should be the implementation of Construction and Operational Environmental Management Plans (CEMP and OEMP) and Sediment and Erosion Control Plan.

Sensitive receptors and recommendations and mitigation measures specific to each section are listed below in Table 7. These should be incorporated into the overall management plan relating to protection of biodiversity for the entire project including those measures detailed by AECOM (2009).

Table 7 Key Ecological features and recommendations

Key Ecological Features	Recommendation / Management
Stage 1 GFDA Extension	
▪ Native vegetation nearby	▪ All well sites should be located outside of these areas.
▪ Drainage lines	▪ Routes for access tracks and gathering lines should be located along existing tracks and should avoid drainage lines where possible.
▪ Grey-crowned Babbler	▪ Recorded in vegetation adjacent to GFDA and likely to be relatively common within this area. The CEMP and OEMP should specifically address protection and management regimes for this species.
Amended Pipeline KP 17 – 25	
▪ Route passes through native vegetation	▪ Limit clearing within areas of remnant and regrowth vegetation.
▪ Drainage lines	▪ Pipeline route and access tracks should be located along existing tracks and should avoid drainage lines where possible.
Amended Pipeline KP 27.5	
▪ Ramstation Creek	▪ If open trenching is proposed then clearing should be confined to as narrow a corridor as possible (15 m). ▪ Water flows should be maintained and stringent measures to avoid erosion and downstream sedimentation and spread of weeds should be implemented.

Key Ecological Features	Recommendation / Management
Amended Pipeline KP 71.5 – 83	
▪ Intact remnant vegetation	▪ Although the pipeline largely follows a powerline easement additional clearing along this easement should be limited. ▪ Where possible the already cleared easement should be used for laydown areas, spoil storage and tracks.
▪ *Hunter Lowland Redgum Forest* (EEC) ▪ Mapped as 'Marginal" habitat for Koala under the Port Stephens Council CKPoM.	▪ Where the proposed pipeline route traverses the *Hunter Lowland Redgum Forest* a path should be chosen so as to avoid trees where possible. ▪ Clearing should also be minimised to an average of 5 m throughout. ▪ The provision of habitat offsets may be required. ▪ Where the proposed pipeline route passes to the north of the *Hunter Lowland Redgum Forest* stringent management measures to avoid indirect impacts should be implemented, e.g. fencing of the northern boundary of the woodland, ensuring siltation curtains are in place and regularly checked.
▪ Deadmans Creek ▪ Mapped as 'Preferred" Koala habitat for Koala under the Port Stephens Council CKPoM.	▪ HDD should be used to pass under this creek and riparian area.
Amended Pipeline KP 89.5 – 96	
▪ Hunter River ▪ Hunter Estuary National Park is located downstream of the crossing points of the Hunter River north arm. ▪ SEPP 14 Coastal Wetlands No. 830 and 831. ▪ Water bird habitat and saltmarsh. ▪ Other TSC and EPBC Act listed species.	▪ HDD to be used for Hunter River crossing and SEPP 14 wetlands. ▪ Where the pipeline route traverses the caravan park and Old Punt Road stringent management measures to avoid indirect impacts on wetlands and estuary should be implemented. ▪ Goal for construction and operation – no direct or indirect impacts on the Hunter River and SEPP 14 wetlands.

Key Ecological Features	Recommendation / Management
Laydown Areas	AECOM (2009) recommend the following measures to minimise clearing of native vegetation required for construction purposes, including lay down areas. Adoption of the following locational principles to locate envelopes for gas wells, flowlines and CPF include: ▪ not within 100 m of existing residences or as required to meet project noise goals; ▪ minimum of 40 m from a watercourse; ▪ avoiding native vegetation (about 6% of GFDA) and riparian areas; ▪ avoiding Indigenous and European heritage places or items; ▪ located adjacent to existing fence lines and access tracks where possible; ▪ located on relatively flat ground (i.e. less than 10% gradient); ▪ considering visual effects and opportunistic use of natural screening such as vegetation; and ▪ considering land use and landowner preferences.

Mitigation measures should be aimed at meeting the following performance objectives and goals:

5.1.1 Performance Objectives

- To minimise impacts on remaining biodiversity values of the site; and
- Protect biodiversity values across the locality.

5.1.2 Goals

Goals for the proposed works should be to:

- Minimise the amount of vegetation to be removed;
- Protect the remaining vegetation and fauna habitat;
- Ensure that erosion of the works areas does not occur and that sedimentation of adjacent areas is avoided; and
- Ensure that impacted areas are protected from erosion and weed invasion and restored to their current levels at the completion of the drilling operations.

The recommendations and mitigation measures detailed in AECOM (2009) should also be implemented in the Stage 1 GFDA extension and along the sections of amended pipeline route.

Particular attention should be focussed on avoiding direct and indirect impacts to the *Hunter Lowland Redgum Forest* and indirect impacts to occurrences of *Swamp oak floodplain Forest* which occur adjacent to the amended pipeline route. Of particular importance will be the need to minimise changes to natural flow regimes of rivers, streams, floodplains and wetlands as much of the southern section of the amended pipeline route traverses low lying water-logged areas. Central to these measures should be the preparation and implementation of a CEMP and OEMP.

5.2 Specific Conservation Measures Relating to Biodiversity

A number of measures are recommended to be implemented to specifically protect threatened species, populations and endangered ecological communities along the proposed pipeline route and / or in adjacent areas, including:

i) The placement of well sites within vegetated areas should be avoided;

ii) A path should be chosen through woodland areas which requires the least amount of trees to be removed;

iii) Top soil (< 100 mm) should be stockpiled when clearing vegetation and this should then be spread over the surface once the trench has been backfilled;

iv) Pre-trenching surface levels should be restored once backfilling is complete to retain current surface hydrology;

v) Where possible, removed native vegetation should be stockpiled and spread back over the work area on completion of the project;

vi) Weedy vegetation should not be spread but instead removed off site;

vii) Paddock trees should be avoided;

viii) A no impact zone around large trees especially those containing hollows, twice the radius of the tree canopy should be maintained; and

ix) Use pre-existing tracks to avoid further damage to vegetation.

6 CONCLUSIONS

The route of the amended proposed pipeline and Stage 1 GFDA extension have in general been designed to either avoid areas of conservation significance or where these could not be avoided then horizontal directional drilling has been proposed to mitigate against impacts associated with traditional trenching techniques of watercourse crossings, and areas of native vegetation clearance have largely been confined to the edges of already fragmented ecosystems.

Assessments under the Part 3A of the NSW EP&A Act including those species, populations and communities listed under the TSC Act, concluded that significant impacts are unlikely given the modified nature of the Stage 1 GFDA extension area and the amended pipeline route, as long as stringent environmental management measures are implemented. Similarly, it is concluded that matters of NES listed under the Commonwealth EPBC Act would not be significantly impacted as long as stringent management and mitigation measures are also implemented.

To ensure the protection of native vegetation communities, a range of measures to manage risks to the neighbouring native vegetation communities and aquatic environments during construction and operation, are recommended with the aim of protecting existing biodiversity. It is important that a Sediment and Erosion Management Plan be prepared for the proposed construction works as there is the risk of spread of weeds and erosion during construction and it is recommended that those mitigation measures recommended in AECOM (2009) be adopted for the amended sections of the pipeline route and Stage 1 GFDA extension. With these measures in place it is unlikely that this proposal would have significant impacts on threatened species, population or ecological communities listed under the TSC Act and EPBC Act. Consequently, it is considered that the guiding principles of the proposal deliver the environmental outcomes shown in Table 8.

Table 8 Environmental outcomes of the proposal

Environmental Outcome	Does the Proposal Deliver?
Maintain or improve biodiversity values	Biodiversity values are unlikely to be substantially altered from their current values as the majority of the proposed pipeline route is cleared agricultural / mining lands. Areas of native vegetation removal would be confined to relatively narrow linear strips of either regrowth or remnant vegetation communities. Native vegetation removal would total 4.78 ha over 26 km. 0.23 ha of these are the EEC, *Hunter Lowland Redgum Forest*. Without the provision of offsets this proposal is unlikely to maintain or improve biodiversity values.
Conserve biological diversity and promote Ecologically Sustainable Development (ESD)	The pipeline route was designed with due consideration to the significant biological diversity in the area. Where possible native vegetation has been avoided as have areas of high biological diversity and significance. Where these areas could not be avoided modified construction techniques would be implemented including HDD and reduced width of clearing. Stringent environmental management measures would be implemented further assisting in the

Environmental Outcome	Does the Proposal Deliver?
	conservation of biological diversity and the promotion of Ecologically Sustainable Development.
Prevent the extinction of threatened species.	The proposed pipeline route has been located so as to avoid areas of high biodiversity which would be most likely to provide habitat to listed species and endangered ecological communities. In unavoidable areas of high conservation significance alternate construction methods would be utilised. Taken together it is considered that these measures would prevent the extinction of threatened species.
Protect the long-term viability of local populations of a species, population or community.	The area of direct impact is relatively small and with the implementation of stringent mitigation and environmental management measures it is considered that the long-term viability of local species, populations and communities would be protected.

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APPENDIX A

Dominant Flora Species Recorded Within Amended Areas

APPENDIX A

Gloucester Coal Seam Gas Project - Gloucester to Hexham

Ecological Addendum Report

Dominant Flora Species Recorded in June 2009

			Amended Areas Rev E			
Family	**Scientific Name**	**Common Name**	**KP 18-26**	**KP 29**	**KP 73-84**	**KP 90-95**
Acanthaceae	*Avicennia marina*	Grey Mangrove				x
Adiantaceae	*Adiantum aethiopicum*	Maidenhair Fern	x	x	x	
	Cheilanthes sieberi subsp. *sieberi*	Mulga Fern	x		x	
Amygdalaceae	*Prunus* sp. *		x		x	
Apocynaceae	*Parsonsia straminea*	Common Silkpod			x	
Asteraceae	*Bidens pilosa**	Cobblers Peg	x		x	x
	*Cirsium vulgare**	Spear Thistle	x			
	Euchiton involucratus	Star Cudweed				
	Senecio madagascariensis *	Fireweed	x		x	x
	Sigesbeckia orientalis subsp. *orientalis* *	Indian Weed	x		x	
Bignoniaceae	*Pandorea pandorana* subsp. *pandorana*	Wonga Wonga Vine			x	
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell			x	
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak	x		x	
	Casuarina cunninghamiana	River Oak	x	x	x	x
	Casuarina glauca	Swamp Oak				x
Convolvulaceae	*Dichondra repens*	Kidney Weed	x		x	x
Cyperaceae	*Carex* sp.	A sedge	x	x		x
	Gahnia aspera	Rough Saw-sedge	x		x	
	Schoenoplectus mucronatus				x	
Dennstaedtiaceae	*Pteridium esculentum*	Common Bracken	x		x	
Dilleniaceae	*Hibbertia* sp.	Guinea-flower	x			
Droseraceae	*Drosera* sp.	Sundew			x	
Ericaceae - Styphelioideae	*Lissanthe strigosa*	Peach-heath	x		x	
	Leucopogon juniperinus	Prickly Beard-heath	x		x	
Euphorbiaceae	*Glochidion ferdinandi*	Cheese Tree	x		x	

			Amended Areas Rev E			
Family	**Scientific Name**	**Common Name**	**KP 18-26**	**KP 29**	**KP 73-84**	**KP 90-95**
Fabaceae - faboideae	*Daviesia ulicifolia*	Gorse Bitter Pea	x		x	
	Glycine clandestina		x			
	Glycine tabacina				x	
	Hardenbergia violacea	Purple Coral Pea		x	x	
	Jacksonia scoparia	Dogwood			x	
	Kennedia rubicunda	Dusky Coral Pea	x		x	
	Podolobium ilicifolium	Prickly Shaggy Pea			x	
	Pultenaea ferruginea	Large Bronze Bush-pea			x	
Fabaceae - mimosoideae	*Acacia parramattensis*	Parramatta Wattle	x		x	
	Acacia parvipinnula	Silver-stemmed Wattle	x		x	
	Acacia ulicifolia	Prickly Moses	x		x	
Juncaceae	*Juncus acutus*	Sharp Rush				x
	Juncus pallidus		x	x		
Lauraceae	*Cassytha glabella*				x	
Lobeliaceae	*Pratia purpurascens*	Whiteroot	x		x	
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		x	x	
	Lomandra multiflora		x		x	
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily			x	
Malvaceae	*Hibiscus heterophyllus*	Native Rosella		x		
Moraceae	*Ficus rubiginosa*	Port Jackson Fig	x			
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle	x	x		
	Corymbia maculata	Spotted Gum	x		x	
	Eucalyptus crebra	Narrow-leaved Ironbark	x		x	
	Eucalyptus eugenioides	Thin-leaved Stringybark			x	
	Eucalyptus moluccana	Grey Box	x		x	
	Eucalyptus propinqua	Small-fruited Grey Gum	x		x	
	Eucalyptus punctata	Grey Gum	x		x	
	Eucalyptus siderophloia	Grey Ironbark	x	x	x	
	Eucalyptus teretecornis	Forest Red Gum	x	x	x	
	Eucalyptus umbra	Broad-leaved White Mahogany	x	x	x	
	Melaleuca linariifolia	Flax-leaved Paperbark	x	x	x	x
	Melaleuca styphelioides	Prickly-leaved Tea Tree	x	x	x	
Oleaceae	*Ligustrum sinense* *	Small Leaved Privet			x	

			Amended Areas Rev E			
Family	**Scientific Name**	**Common Name**	**KP 18-26**	**KP 29**	**KP 73-84**	**KP 90-95**
	Notelaea venosa	Veined Mock-olive		x		
Orchidaceae	*Dendrobium aemulus*	Ironbark Orchid	x			
Phormiaceae	*Dianella caerulea* var. *producta*	Blue Flax-lily			x	
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	x			x
Pinaceae	*Pinus radiata* *	Radiata Pine				x
Pittosporaceae	*Bursaria spinosa*	Blackthorn	x		x	
Plantaginaceae	*Plantago lanceolata* *	Lamb's Tongue	x	x	x	
Poaceae	*Andropogon virginicus* *	Whisky Grass			x	x
	Aristida vagans	Threeawn Speargrass	x		x	
	Cortaderia selloana *	Pampas Grass				x
	Corymbia gummifera	Red Bloodwood			x	
	Cymbopogon refractus	Barbed Wire Grass	x		x	
	Cynodon dactylon	Couch	x	x	x	x
	Echinopogon ovatus	Forest Hedgehog Grass			x	
	Entolasia marginata	Bordered Panic	x		x	
	Entolasia stricta	Wiry Panic			x	
	Imperata cylindrica	Blady Grass	x		x	
	Microlaena stipoides	Weeping Grass	x	x	x	x
	Oplismenus aemulus				x	
	Pennisetum clandestinum *	Kikuyu	x		x	x
	Phragmites australis	Common Reed				x
	Sporobolus fertilis *	Giant Parramatta Grass	x			
	Stenotaphrum secundatum *	Buffalo Grass			x	
	Themeda australis	Kangaroo Grass	x		x	
Polygonaceae	*Persicaria decipiens*	Slender knotweed			x	
	Persicaria strigosa				x	
Proteaceae	*Grevillea robusta* *	Silky Oak				x
Ranunculaceae	*Clematis aristata*	Old Man's Beard		x	x	
Rhamnaceae	*Alphitonia excelsa*	Red Ash		x	x	
Rosaceae	*Rubus fruiticosus* *	Blackberry	x	x	x	x
Rosaceae	*Rubus parvifolius*	Native Raspberry	x			
Salicaceae	*Salix babylonica* *	Weeping Willow				x
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	x		x	

			Amended Areas Rev E			
Family	**Scientific Name**	**Common Name**	**KP 18-26**	**KP 29**	**KP 73-84**	**KP 90-95**
Solanaceae	*Solanum linnaeanum* *	Apple of Sodom		x	x	
Sterculiaceae	*Brachychiton acerifolius*	Flame Tree	x			
	Brachychiton populneus	Kurrajong			x	
Urticaceae	*Pennisetum clandestinum*	Stinging Nettle		x		
Verbenaceae	*Lantana camara* *	Lantana	x		x	x
	Verbena rigida	Veined Verbena	x			x
Note: * denotes introduced species						