Young to Wagga Wagga Looping Pipeline

APA Group

31 January 2010

Document No. 60102333-EA.1

Environmental Assessment

Stage 1
Volume 2

Appendix A

Director General's Environmental Assessment Requirements and Agency Comments

NSW GOVERNMENT
Department of Planning

Contact: Marek Cholinski
Phone: (02) 9228 6284
Fax: (02) 9228 6366
Email: marek.cholinski@planning.nsw.gov.au

Our ref: S09/00434

Mr Geoff Callar
Manager Asset Management Systems
APA Group
PO Box R41 Royal Exchange
Royal Exchange NSW 1225

Dear Mr Callar

Proposed Young to Wagga Wagga Looping Pipeline, Young, Harden, Cootamundra, Junee and Wagga Wagga Local Government Areas (Application Reference: 09_0097)

The Department has received your major project application and request for Director-General's Requirements (DGRs) for the above mentioned proposal.

The Director-General's Environmental Assessment Requirements are attached, pursuant to section 75F(2) of the *Environmental Planning and Assessment Act 1979*. These requirements are based on the information provided to date, including the Planning Focus Meeting held on 7 April 2009 and through consultation with relevant government agencies. 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.

Please contact the Department at least two weeks before you propose to submit the Environmental Assessment for the project 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 project 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 project (6274 1111 or http://www.environment.gov.au).

If you have any enquiries about these requirements, please contact Mr Marek Cholinski, Environmental Planning Officer, Major Infrastructure Assessments on 02 9228 6284 or via email (marek.cholinski@planning.nsw.gov.au).

Yours sincerely

4.7.09

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

DRAFT Director-General's Requirements Section 75F of the *Environmental Planning and Assessment Act 1979*	
Project	Construction and operation of a buried, high pressure gas transmission pipeline which will loop the existing 12" Young to Wagga Wagga Pipeline with an 18" Pipeline. The existing pipeline is licensed by the Department of Water and Energy as Licence 19. The new pipeline will be approximately 130 km in length and it is intended to be laid within the easement of the existing pipeline. The project includes: • constructing a range of temporary work and storage facilities; • access track development to areas of works ; • haulage via road on extended semi-trailers; • 30 metre easement widths for construction of the pipeline through open country; • excavation, drilling and interim spoilage storage, replacement, remediation or disposal; • laying, welding and lowering of pipe subject to non-destructive test inspection and hydro testing; • laying out of the pipe (stringing) adjacent to the trench and held off the ground on skids; • sourcing water for hydro testing; • cleaning up and restoring sites following completion of construction; • routine operation and maintenance for the existing pipeline would be extended for the looping pipeline; • connecting the pipeline to the Young Base SCADA system; • operating the looped pipeline in conjunction with the existing Licence 19 pipeline; and • installing security fencing, marker posts, cathodic protection test points and gates and locks around all major above ground facilities (e.g. scraper stations and mainline valves).
Site	Land within the following local government areas: Young, Harden, Cootamundra, Junee and Wagga Wagga. The pipeline will run north east from the Bowmen Meter and Scrapper Station. The area is predominantly used for grazing and cropping.
Proponent	East Australian Pipeline Pty Ltd (EAPL)
Date of Issue	04/07/2009
Date of Expiration	04/07/2011
General Requirements	The Environmental Assessment (EA) must include: • an **executive summary**; • a **detailed description** of the project including: construction and operation details that clearly define the proposal corridor, access routes and any ancillary facilities; • consideration of any **relevant statutory provisions** including the consistency of the project with the objects of the *Environmental Planning and Assessment Act 1979;* • an **assessment of the key issues** outlined below, during construction, operation and decommissioning (as relevant); • a **draft Statement of Commitments** detailing measures for environmental mitigation, management and monitoring for the project; • a **conclusion justifying the project** taking into consideration the environmental, social and economic impacts of the project; 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 assessment of the following key issues: • **Strategic Planning and Project Justification** – the Environmental Assessment must provide a strategic assessment of the project, including justification of the need, scale, scope and location for the project, with particular reference to the existing Australian pipeline network, the location of gas reserves and areas of gas demand and expected demand growth. The Environmental Assessment must

include an analysis of the required capacity of the project, having regard to existing gas supplies and the potential for additional known reserves to be connected into the project.

- **Land Use Planning Impacts** – the Environmental Assessment must assess the potential for the project to generate land use conflicts, particularly with respect to Crown land, mineral reserves, conservation areas, land of high agricultural value (the agricultural land classes should be clearly shown) and areas of significant scenic or visual value;
- **Ecological Impacts** – the Environmental Assessment must include a justified and tiered assessment approach for impacts of the project on native vegetation, threatened species, populations, ecological communities and their habitats for each bioregion (including both terrestrial and aquatic ecology). The Environmental Assessment must:
  - identify bioregions that will be or may be impacted by the project;
  - demonstrate a design philosophy of impact avoidance on ecological values, and in particular, ecological values of high significance;
  - 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 project;
  - for species, populations, ecological communities and habitats with high ecological significance and significant potential for impact, include sufficient information to demonstrate the likely impacts, consistent with *Guidelines for Threatened Species Assessment* (DEC & DPI, July 2005)
  - for other species, populations, ecological communities and habitats, a general bioregion-based assessment of ecological impacts associated with the project;
  - consider region-based ecological outcomes, including habitat connectivity, remanent vegetation within road reserves and distribution of species, and how these may be impacted by the project;
  - detail measures to avoid or mitigate impacts, including any proposed compensatory habitat, revegetation or off-set strategy, that describes the scale, scope and timing of implementation;
- **Heritage Impacts** – the Environmental Assessment must include sufficient information to demonstrate the likely impacts on Aboriginal heritage values/items and outline proposed mitigation measures in accordance with the Draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005). The Environmental Assessment must demonstrate effective consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and selecting options and mitigation measures. The assessment must also demonstrate any impacts to non-indigenous heritage sites should they occur along the proposal.
- **Human Amenity Impacts** – the Environmental Assessment must include a justified and tiered assessment approach for impacts on human amenity, including noise and vibration, air quality (dust and odour) and traffic impacts during construction and operation of the project. The Environmental Assessment must:
  - identify human receptors that will be or may be impacted by the project;
  - characterise potentially impacted human receptors in terms of receptor type (e.g. isolated receptors, receptor areas (such as residential zones) and sensitive receptors (such as schools, hospitals etc))
  - identify those receptors and receptor types likely to be significantly impacted by the project;
  - include a framework for the mitigation, management and monitoring of noise and air quality impacts during construction of the project, particularly with respect to receptors and receptor types likely to be significantly impacted by the project and with specific reference to noise- and vibration-intensive construction works/ activities (drilling, blasting, bulk excavation, heavy vehicle movements etc) around receptors and major centres.
- **Socio-Economic Implications** – the Environmental Assessment must assess the potential for the project to influence the socio-economic profile of major centres and regions along the project route. The Environmental Assessment, where relevant, must also reflect a design philosophy to support the potential for

	domestic, commercial and industrial connection to gas supplies in major centres where feasible and appropriate in future. • **Hazards and Risk Impacts** – the Environmental Assessment must include an assessment of the hazards and risk impacts of the project, prepared generally consistent with the approach outlined in *Hazardous Industry Planning Advisory Paper No. 6* (DoP, 1992) and *Multi-level Risk Assessment* (DUAP, 1997), and with specific reference to applicable Australian Standards (including AS2885 Pipelines - Gas and Liquid Petroleum – Operation and Maintenance). The Environmental Assessment shall specifically consider on-going maintenance and safety management of the project, including potential impacts on and from bushfires and floods. • **Surface and Groundwater Impacts** – the Environmental Assessment must include a justified and tiered assessment approach for impacts on surface water and potential for groundwater interception along the length of the project, including any stream crossings. In particular, the sources of water and disposal of water (from hydro testing) must be detailed. • **Infrastructure Impacts** - the Environmental Assessment must include a justified and tiered assessment approach for impacts on infrastructure, including roads, rail, electricity, gas and water supply infrastructure. Mitigation measures to counter or rectify these impacts shall be described. • **Traffic and Transport Impacts** – The Assessment must assess the construction and operational traffic impacts of the project including proposed routes, timing and traffic volumes. • **General Environmental Risk Analysis** – notwithstanding the above key assessment requirements, the Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), an outline of the 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, a framework for the consideration of the additional key environmental impact(s) must be included in the Environmental Assessment.
Consultation Requirements	You must undertake an appropriate and justified level of consultation with the following parties during the preparation of the Environmental Assessment: • Commonwealth Department of the Environment, Water, Heritage and the Arts • NSW Department of Primary Industries; • Relevant Catchment Management Authorities; • NSW Department of Water and Energy, Country Energy and Transgrid; • NSW Roads and Traffic Authority and Australian Rail Track Corporation; • NSW Department of Lands, relevant Landcare Groups and relevant Rural Lands Protection Boards; • relevant local aboriginal communities and Local Aboriginal Land Councils; • local councils of Young, Harden, Cootamundra, Junee and Wagga Wagga. In addition, appropriate consultation with the local community should be undertaken. The Environmental Assessment must clearly indicate issues raised by stakeholders during consultation, and how those matters have been addressed in the Environmental Assessment.
Deemed refusal period	60 days

Our reference: FIL06/1315-04;DOC09/26280

Manager – Water and Energy
Major Infrastructure Assessments
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Attention: Marek Cholinski

Dear Mr Osborne

Re Proposed Young to Wagga Wagga pipeline – Application Reference: 09_0097

I refer to your letter dated 11 June 2009 to the Department of Environment and Climate Change (DECC) seeking our requirements for the Environmental Assessment (EA) that is being prepared for the looping gas pipeline between Young and Wagga Wagga.

We have considered the details of the proposal as provided in your correspondence and supplied at the planning focus meeting on the 11 June 2009. From this we have identified the information required for DECC to assess this proposal as outlined in Attachment 'A'. In summary, the DECC key information requirements for the project are as follows.

- Impacts on flora and fauna;
- Impacts on threatened species occurring in and around the pipeline easement and any associated track construction;
- Proposed rehabilitation of areas temporarily disturbed;
- Assessment of any impacts the project may have on Aboriginal cultural heritage; and
- The action that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts identified in the above.

In carrying out the assessment the applicant should refer to the relevant guidelines identified at Attachment 'B'.

We wish to advise that based on the information provided the proposed activity is not a scheduled activity under the *Protection of the Environment Operations Act 1997*.

PO BOX 397 Griffith NSW 2680
Suite 7, 130-140 Banna Avenue Griffith NSW
Tel: (02) 6969 0700 Fax: (02) 6969 0710
ABN 30 841 387 271
www.environment.nsw.gov.au

Department of **Environment and Climate Change** NSW

If you have any further enquiries about this matter please contact me by telephoning 02 6969 0700.

Yours sincerely

Jason Price 23.6.09

JASON PRICE
Acting Head, Griffith Unit
Environment Protection and Regulation

ATTACHMENT 'A'

1. Environmental impacts of the project

The following environmental impacts of the project need to be assessed, quantified and reported on.

(a) Air;
(b) Noise;
(c) Water; and
(d) Waste.

The Environmental Assessment (EA) should address how the required environmental outcomes and goals will be met for each impact. The EA should also describe mitigation and management options that will be used to prevent, control, or abate identified environmental impacts associated with the project and to reduce risks to human health and prevent the degradation of the environment.

(a) Impacts on air quality

The goal of the project in relation to air quality should be to ensure sensitive receptors are protected from any adverse impacts from dust.

Dust is a concern with potential emissions including but not necessarily limited to material handling and processing, construction activities, traffic movements, and open exposed areas. Details would need to be provided on the proposed measures to manage dust from these activities and their performance. The EA will need to detail the adequacy of available water supply to ensure any dust controls involving the suppression of water are not compromised during extended dry periods.

Should the proposal include concrete batching operations, the EA will need to describe the dust control equipment proposed at this plant.

The Department of Environment and Climate Change (DECC) expects that an assessment for dust be undertaken in accordance with our guidelines (as listed in Attachment 'B') and in conjunction with analyses of local meteorologic and terrain data in order to inform decisions about design and management options for the proposed development.

(b) Impacts of noise

The goal of the project should be to ensure that the nearest sensitive receptors are considered through design, construction, operation and maintenance so that there are no adverse impacts from noise.

The DECC expects that potential noise sources are assessed in accordance with the 'NSW Industrial Noise Policy' (DECC, 2000), and where required mitigation measures are proposed (e.g. appropriate equipment chosen to minimise noise levels). All residential or noise sensitive premises likely to be impacted by the development must be identified and included in the assessment.

Where blasting is intended at the site establishment or construction stage, the following details of the blast design should be included in the noise assessment:

- bench height, burden spacing, spacing burden ratio;
- blast hole diameter, inclination and spacing;

- type of explosive, maximum instantaneous charge, initiation, blast block size, blast frequency;
- times of blasting.

(c) Impacts on water quantity and quality

The goal of the project should ensure:

- There is no pollution of waters (including surface and ground waters);
- Polluted water is captured on the site and collected, treated and beneficially reused, where this is safe and practicable to do so; and
- It is acceptable in terms of the achievement or protection of the River Flow Objectives and Water Quality Objectives.

The EA should document the measures that will achieve the above outcomes and should also quantify all waste water streams and characterise the quality of these waste waters. Proposed water pollution controls should be identified.

The EA should detail the sediment controls that will be used for all areas that will be disturbed by the project, particularly those areas which will require roads to be constructed on steep gradients.

The EA needs to include a hydro-geological assessment that assesses potential ground water impacts and any potential impacts to surrounding waterways and water dependent ecosystems.

(d) Waste

The goal of the development should ensure:

- It is in accordance with the principles of the waste hierarchy and cleaner production;
- The handling, processing and storage of all materials used at the premises does not have negative environmental or amenity impacts;
- The beneficial reuse of all wastes generated at the premises are maximised where it is safe and practical to do so;
- No waste disposal occurs on site except in accordance with an Environment Protection Licence.

2. Impacts of the project on threatened species and their habitat

As a Part 3A development it is required to satisfy the requirements for flora and fauna impact assessment in accordance with the "Draft Guidelines for Threatened Species Assessment" under s75 (F) of the *Environmental Planning and Assessment Act 1979.*

The EA will need to consider direct and indirect impacts on threatened species and their habitat. In addition to this, the EA will need to ensure that an adequate flora and fauna impact assessment is included for the pipeline easement, associated infrastructure and access tracks.

If any clearing is to take place compensatory measures should be considered to maintain and improve habitat on the development site. Any revegetation program needs to have regard to the vegetation communities naturally occurring on site and the habitat requirements of flora and fauna. Where applicable, a detailed revegetation plan must be prepared and integrated into the development proposal.

The EA needs to address the following:

1. A field survey of the site should be conducted in accordance with the draft document "Guidelines for threatened species assessment".
2. Potential impacts on threatened species and their habitat need to be assessed, evaluated and reported on. The assessment should specifically report on the considerations listed in Step 3 of the draft guideline.
3. Describe the actions that will be taken to avoid or mitigate potential impacts or compensate to prevent unavoidable impacts of the project on threatened species and their habitat. This should include an assessment of the effectiveness and any residual impacts after these measures are implemented, and the impacts and implications for biodiversity of any concurrent management activities within the development footprint.
4. The EA needs to clearly state whether it meets each of the key thresholds set on Step 5 of the draft guideline.

3. <u>Impacts of the project on Aboriginal cultural heritage values</u>

1. The EA should address and document the information requirements set out in the "Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation" involving surveys and consultation with the Aboriginal community.
2. Identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area.
3. Describe the actions that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts of the project on Aboriginal cultural heritage values. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.
4. The EA needs to clearly demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and making final recommendations.

ATTACHMENT 'B'

GUIDANCE MATERIAL

1. Assessing Environmental Impacts

Air quality

- *Protection of the Environment Operations (Clean Air) Regulation 2002*
- Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales (DECC, 2005)
- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DECC, 2005)
- Assessment and Management of Odour from Stationery Sources in NSW (DECC, 2006)

Noise and vibration

- South Australian Wind Farm Guidelines (South Australia EPA, 2003)
- NSW Industrial Noise Policy (DECC, 2000)
- Environmental Criteria for Road Traffic Noise (DECC, 1999)
- Assessing Vibration: a technical guideline (DECC, 2006)
- Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZECC, 1990)
- Environmental Noise Control Manual: Chapter 171 - Construction Site Noise (DECC, 1994)

Water quality

- National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000)
- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000)
- Using the ANZECC Guidelines and Water Quality Objectives in NSW (DECC, 2006)

Groundwater

- The NSW State Groundwater Policy Framework Document (DLWC, 1997)
- The NSW State Groundwater Quality Protection Policy (DLWC, 1998)
- The NSW State Groundwater Dependent Ecosystems Policy (DLWC, 2002)
- National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC, 1995)

Stormwater

- Managing Urban Stormwater: Soils and Construction (Landcom, 2004)
- Managing Urban Stormwater: Treatment Techniques (Draft) (DECC, 1997)

Wastewater

- National Water Quality Management Strategy - Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) (EPHC, 2006)
- National Guidelines for Water Recycling - Managing Health and Environmental Risks - Impact Assessment (EPHC, 2005)
- Environmental Guidelines: Use of Effluent by Irrigation (DECC, 2004)

Waste

- Waste Classification Guidelines (DECC, 2008)
- Environmental Guidelines: Use and Disposal of Biosolids Products (DECC, 1997)
- Technical guidelines: Bunding and Spill Management (DECC, 1997)

2. Assessing Threatened Species Impacts

- Threatened Species Assessment Guidelines - The Assessment of Significance (DECC, 2007)
- Draft Guidelines for Threatened Species Assessment (DECC & DPI, 2005)
- Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft) (DECC, 2004)

3. Assessing Aboriginal Cultural Heritage Impacts

- Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DECC, 2005)
- Aboriginal Cultural Heritage Standards and Guidelines Kit (DECC, 1997)

Neville Osborne
Manager – Water and Energy
Major Infrastructure Assessments
Department of Planning
GPO Box 39, Sydney NSW 2001

Our ref: 09/3781
Your ref: S09/00434

Dear Neville,

Re: Proposed Young to Wagga Wagga Looping Pipeline, Young, Harden, Cootamundra, Junee and Wagga Wagga Local Government Areas (Application Reference: 09_0097)

Thank you for your letter of 12th June 2009 regarding the Director General's Requirements and additional key issues relating to the above proposal.

Given that the pipeline is to be constructed within the existing pipeline easement NSW DPI considers the draft environmental assessment requirements prepared for the proposal to date to be adequate and has no additional key issues to raise.

Should you wish to discuss the matters mentioned above please contact Cressida Gilmore of the Minerals Division via email (cressida.gilmore@dpi.nsw.gov.au) or on (02) 4931 6537.

If you have any further queries on this matter please contact Cressida Gilmore, Land Use on 4931 6537 (Minerals).

Yours sincerely,

C Gilmore

pp
Iain Paterson
Acting Team Leader, Land Use

23rd June 2009

Marek Cholinski - Re: Young to Wagga Wagga looping pipeline proposal

From: Darren Wallett
To: Marek Cholinski
Date: 29/06/2009 4:46 PM
Subject: Re: Young to Wagga Wagga looping pipeline proposal

Hi Marek,

The DGR's are fine for the pipeline proposal. They key issues which you have indicated are waterway crossings and water supply. The other issue would be the potential for groundwater interception if the pipeline passes through areas of shallow groundwater. You may want to include that point in your DGR's.

Cheers Darren.

Darren J Wallett

Senior Planning and Assessment Coordinator
Major Projects & Assessments Unit-Southern Central
NSW Department of Water and Energy

PO Box 5336
Wagga Wagga NSW 2650
Ph 0269 329119
Mobile 0427 274 283
Email darren.wallett@dnr.nsw.gov.au

>>> Marek Cholinski 26/06/2009 11:56 am >>>
Hi Darren

Just wanted to check if recommendations for Director General's Requirements were sent to the Department regarding the Young to Wagga Wagga looping pipeline proposal.

Hope all is well.

Regards,

Marek Cholinski
Environmental Planner
Major Infrastructure and Assessments
Department of Planning
Ph: (02) 9228 6284
marek.cholinski@planning.nsw.gov.au

Cootamundra Shire Council

Ref: Contact: Jan Godman
Contact: Reference: OUT-090625-JMG-002

MAJOR INFRASTRUCTURE ASSESSMENTS RECEIVED 29 JUN 2009 NSW Department of Planning

Mr N Osborne
Major Infrastructure Assessments
Department of Planning
GPO Box 39
Sydney NSW 2001

Dear Mr Osborne

RE: Proposed Young to Wagga Wagga Looping Pipeline – Young, Harden, Cootamundra, Junee and Wagga Wagga Local Government Areas (Application Reference: 09-0097)

I refer to your letter dated 11th June 2009, regarding the Director-General's environmental assessment requirements in accordance with Section 75F of the EP&A Act in relation to the above project.

Following consideration of the Director-General's requirements, Council requests that in addition to these requirements, consideration be given to the impacts that construction workers and vehicles will have on roads within the Cootamundra Shire.

Should you require further information or wish to discuss this matter please contact Jan Godman, Town Planner or the undersigned on 02 6940 2100.

Yours faithfully

Chris Imrie
Building Surveyor/Environmental Health Officer
for General Manager

25 June 2009

ABN 47 475 920 639
Wallendoon Street
PO Box 420
Cootamundra NSW 2590

Phone 02 6940 2100
Fax 02 6940 2127
Email mail@cootamundra.nsw.gov.au
Web www.cootamundra.local-e.nsw.gov.au

Contact: Jan Godman
Reference: OUT-090709-JMG-001

Mr N Osborne
Major Infrastructure Assessments
Department of Planning
GPO Box 39
Sydney NSW 2001

Dear Mr Osborne

RE: Proposed Young to Wagga Wagga Looping Pipeline – Young, Harden, Cootamundra, Junee, and Wagga Wagga Local Government Areas (Application Reference: 09-0097)

I refer to Council's letter dated 25th June 2009, regarding the Director-General's environmental assessment requirements in accordance with Section 75F of the EP&A Act in relation to the above project.

Council requests that, in addition to the matters previously advised to you, the assessment also give consideration to the following matters in relation to the construction crew carrying out works which are on or adjacent to Council roads:

1. The preparation of traffic control plans which are specific for the gas line crossing roads;
2. The preparation of traffic management plans for activities such as the delivery of pipes and materials as well as the parking of workers vehicles along the route;
3. The preparation of rehabilitation plans for all works on road reserves or other Council owned land; and
4. The preparation of waste management plans for the disposal of all waste.

Should you require further information or wish to discuss this matter please contact Jan Godman, Town Planner or the undersigned on 02 6940 2100.

Yours faithfully

Chris Imrie
Manager Development Services
<u>for General Manager</u>

9 July 2009

Harden Shire Council

HARDEN SHIRE COUNCIL N.S.W

Contact: Sharon Langman
Quote Reference: 12795
Your Reference: S09/00434

PO Box 110
3 East Street
HARDEN NSW 2587
Tel 02 6386 2305
Fax 02 6386 2083
Email council@harden.nsw.gov.au
Web www.harden.nsw.gov.au

25 June 2009

MAJOR INFRASTRUCTURE ASSESSMENTS RECEIVED 29 JUN 2009 NSW Department of Planning

FAXED 25-06-09 M.C

Mr N Osborne
Manager - Water and Energy
Major Infrastructure Assessments
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Dear Mr Osborne

PROPOSED YOUNG TO WAGGA WAGGA LOOPING PIPELINE

Council acknowledges receipt of your correspondence dated 11 June 2009 wherein you request Council's input into the Director General's environmental assessment requirements for the above project.

In addition to the matters identified in the documentation accompanying your correspondence Council would also like the following matters addressed:

1. Protection of Council infrastructure assets during the construction processing. In particular the underboring of roads, disturbance to reticulated water services and access to sites from Council roads should be included in the assessment;
2. The potential of the pipeline to impact upon areas of historic gold diggings, mine workings, miner's camps, etc. This assessment should include actual disturbance as well as visual impact of the infrastructure and security fencing;
3. A description of any site camps, offices or stockpile areas that will be set up. The location, type and length of time should be indicated together with waste disposal measures including any on site effluent;
4. Identify areas where water for testing and dust suppression will be drawn, disposal location for such water and associated impacts on retrieval and receiving areas, particularly in relation to soil disturbance and agricultural reuse;
5. Community notification procedures should blasting be undertaken;
6. Impacts of increased traffic, particularly in relation to turning movements, times and volumes;
7. Details of revegetation, screening and landscaping proposed.

Should you require any further information in this regard, please do not hesitate to contact Council's Customer Services, on (02) 6386 0100 during business hours.

Yours sincerely

Sharon Langman
DIRECTOR ENVIRONMENTAL SERVICES

Our Ref: D03.28 GSR:TPH
12 June 2009

junee

Junee Shire Council
Belmore Street Junee
NSW 2663 (PO Box 93)
Ph: 02 6924 8100
Fax: 02 6924 2497
jsc@junee.nsw.gov.au

Department of Planning
GPO Box 39
SYDNEY NSW 2001

MAJOR INFRASTRUCTURE ASSESSMENTS RECEIVED
19 JUN 2009
NSW Department of Planning

ATTN: Neville Osborne Mauck
Manager - Water and Energy
Major Infrastructure Assessments

Dear Mr Osborne

Proposed Young to Wagga Wagga Looping Pipeline, Young, Harden, Junee, Wagga Wagga Local Government Areas (Application Ref: 09_0097)

Council wishes to acknowledge receipt of your letter dated 11 June 2009.

Council staff attended the focus meeting at Wagga on 11 June 2009 and found that the meeting was helpful in understanding the proposal.

Council noted Local Government key stakeholder representatives voiced the same or similar concerns.

Junee Shire requests that special interest be given to the following:

General Requirements:

(i) bushfire prevention measures during preliminary work, construction work and rehabilitation works;
(ii) erosion control measures during preliminary work, construction work and rehabilitation works;
(iii) rehabilitation to damage or works outside the easement;
(iv) water sourcing and possible re-use of water.

Key Assessment Requirements:

(i) How will the project manage impact on existing wildlife? Eg escape ramps to allow animals to exit the trench, etc.
(ii) Location of a central materials depot for the project to allow for better traffic distribution flows to the various work sites.

If you have any further enquiries, please do not hesitate to contact me.
Yours faithfully

Graham S Ritter
Building Surveyor

City of **Wagga Wagga**

Ref. No: 1226919
Contact: Cameron Collins

8 July 2009

Department of Planning
GPO Box 39
SYDNEY NSW 2001

ATTENTION: MAREK CHOLINSKI

Dear Sir/Madam

Re: PROPOSED YOUNG TO WAGGA WAGGA LOOPING PIPELINE
Your Reference: MP No. 09_0097

I refer to your letter dated 11 June 2009 regarding the above matter. I apologise for the delay in responding to your enquiry.

Council is satisfied that the draft environmental assessment requirements encompass all areas that need to be addressed in the application.

However, Council requests that, in addressing these requirements, the applicant pay specific attention to the following specific matters. These matters reflect a series of issues raised at the recent Planning Focus Meeting held in Wagga Wagga on 11 June 2009.

Activities outside easement

Particular attention should be given to operations occurring outside of the existing easement during the construction phases. It is understood that the proposal will require additional width along certain parts of the easement to allow for works associated with the construction of the pipeline. Whilst it is accepted that the easement itself may be devoid of significant constraints, particular attention must be given to those undefined areas outside the easement.

It is also understood that other works outside the easement may include construction camps, equipment and materials storage, temporary access routes, etc.

Sites for these activities should be carefully planned so as to avoid areas that would result in significant environmental harm (e.g. areas containing remnant vegetation, drainage lines, or other constraints).

Civic Centre PO Box 20 cnr Baylis & Morrow Streets WAGGA WAGGA NSW 2650
TEL: 1300 292 442 (1300 2 WAGGA) **FAX:** (02) 6926 9199
E-mail: council@wagga.nsw.gov.au **Web:** www.wagga.nsw.gov.au **ABN:** 56 044 159 537

All 'off-easement' sites should be clearly and accurately identified as part of any application.

The applications should address how any impacts associated with 'off-easement' activities are to be mitigated with specific reference to each individual area.

Crossings

It is understood that a number of the significant crossings (creek, railway and road) will be under-bored as part of the proposal. It is uncertain as to the proposed method of crossing other minor roads and drainage lines. In this regard, Council is concerned with:

- Potential impact on Council infrastructure within roadways including road pavement and drainage infrastructure; and
- Impacts on remnant vegetation (which is often prevalent within public and crown road corridors).

Rehabilitation

Emphasis should be given to ensuring the timely and progressive rehabilitation of all disturbed areas within and outside of the easement. Particular attention should be given to:

- The reinstatement of temporary access roadways and associated works within and adjacent to public roadways;
- The reinstatement of profiles of creek and other drainage lines;
- Ensuring that the natural profile of the landscape is reinstated; and
- Ensuring that existing vegetation profiles are reinstated.

Access

It is expected that the development will utilise existing access locations to public roads wherever possible to provide access to the easement. It is understood that the development may require the construction of some temporary access locations. Particular attention should be given to:

- Minimising the number of required access locations to public roads;
- Appropriate siting of any new temporary of access locations to public roads.

Fauna

Minimising potential for entrapment and injury while trenches are open.

Thankyou for the opportunity to provide a preliminary response in relation to the proposed Project Application. If you have any questions regarding the above information, please contact Council's Development Services section.

Yours faithfully

Colby Farmer
Development Services Manager

Young Shire Council

Locked Bag 5

2 Short Street
YOUNG NSW 2594

ALL COMMUNICATIONS
TO BE ADDRESSED TO THE
GENERAL MANAGER

General Enquiries,
Finance & Administration: (02) 6380 1200
Environmental & Planning: (02) 6380 1207
Engineering & Utilities: (02) 6380 1215

FAX: (02) 6380 1299

Email: mail@young.nsw.gov.au
Web: http://www.young.nsw.gov.au

Your Ref: S09/00434

Our Ref: 154.00/LS:LS/58587

Contact: L Schweiger

24 June, 2009

MAJOR INFRASTRUCTURE ASSESSMENTS
RECEIVED
29 JUN 2009
NSW Department of Planning

FAXED
24-06-09
M.C

Mr N Osborne
Manager – Water and Energy
Major Infrastructure Assessment
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Dear Mr Osborne,

RE: PROPOSED YOUNG TO WAGGA WAGGA LOOPING PIPELINE

Council acknowledges the receipt of your letter dated 11th June 2009 regarding the above matter, and the planning focus meeting held in Wagga.

Further to this meeting, and the matters identified in the draft Director-Generals Requirements, Council would require the following matters specifically included/addressed in any environmental assessment carried out:

- detailed survey showing the location of the easement, and approximate location of the new and existing pipeline within the easement;
- the location of any dwellings or other sensitive landuses, within close proximity to the pipeline and a subsequent risk assessment;
- detailed assessment of the impact on vegetation, especially within road reserves (Council and Crown), where the some of the most intact examples of remanent vegetation are found within Young Shire Council;
- details on road reinstatement where road crossings occur;
- details of all temporary vehicular access points along the easement;
- details of permanent access locations to the pipeline and/or scraper stations;
- details of sedimentation and erosion controls;
- noise impact assessment during the construction phase.

Should you require any additional information please contact Council on (02) 6382 1466.

Yours sincerely,

K C FILMER
DIRECTOR
PLANNING & ENVIRONMENT

Appendix B

Clause 6 Declaration

Contact: Neville Osborne
Phone: (02) 9228 6337
Fax: (02) 9228 6355
Email: neville.osborne@planning.nsw.gov.au

Our ref: S09/00434
Your ref

Mr Geoff Callar
Manager Asset Management Systems
APA Group
PO Box R41
ROYAL EXCHANGE NSW 1225

Dear Mr Callar

Proposed Young to Wagga Wagga Looping Pipeline – Application of Part 3A of the Environmental Planning and Assessment (EP&A) Act

I refer to your letter dated 9th April, 2009, which sought advice on the application of Part 3A of the EP&A Act to the Young to Wagga Wagga Looping Pipeline proposal.

The Director-General of the Department of Planning, as delegate of the Minister for Planning, has formed an Opinion that the Young to Wagga Wagga Looping Pipeline proposal (as described in your correspondence) will be subject to Part 3A. A copy of the Opinion is enclosed for your information.

Please contact Marek Cholinski on 9228 6284 or myself on 9228 6337 if you would like to discuss this matter.

Yours sincerely

Neville Osborne 24/4/09

Neville Osborne
Manager, 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 4 March 2009, 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 was granted under the *Pipelines Act 1967* before the commencement of clause 26A", 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 loop the existing 12" Young to Wagga Wagga gas pipeline with a 131 km long 18" high pressure gas pipeline, generally as described in the APA Group letter to the Department of Planning, dated 9 April, 2009.

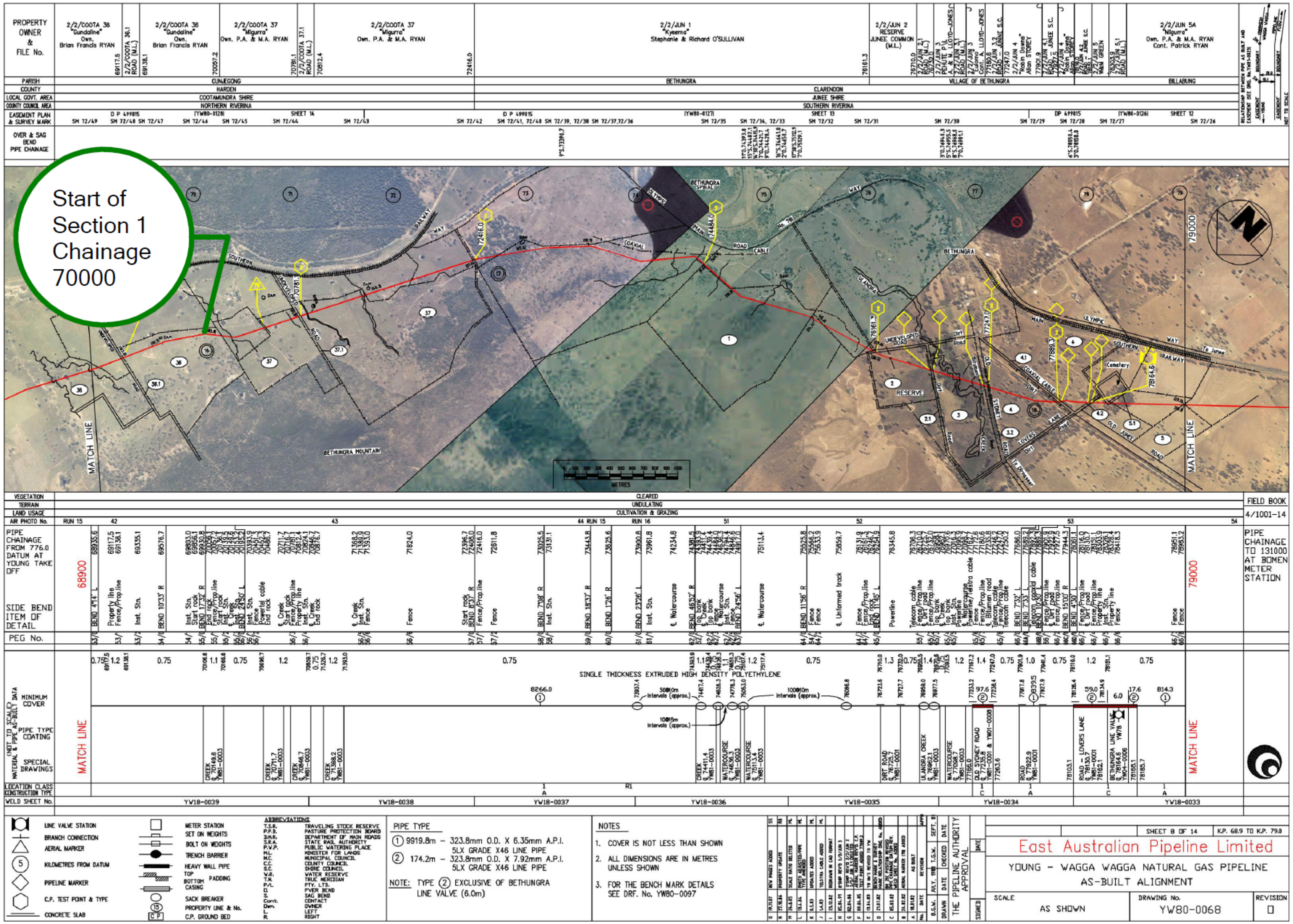
SHaddad

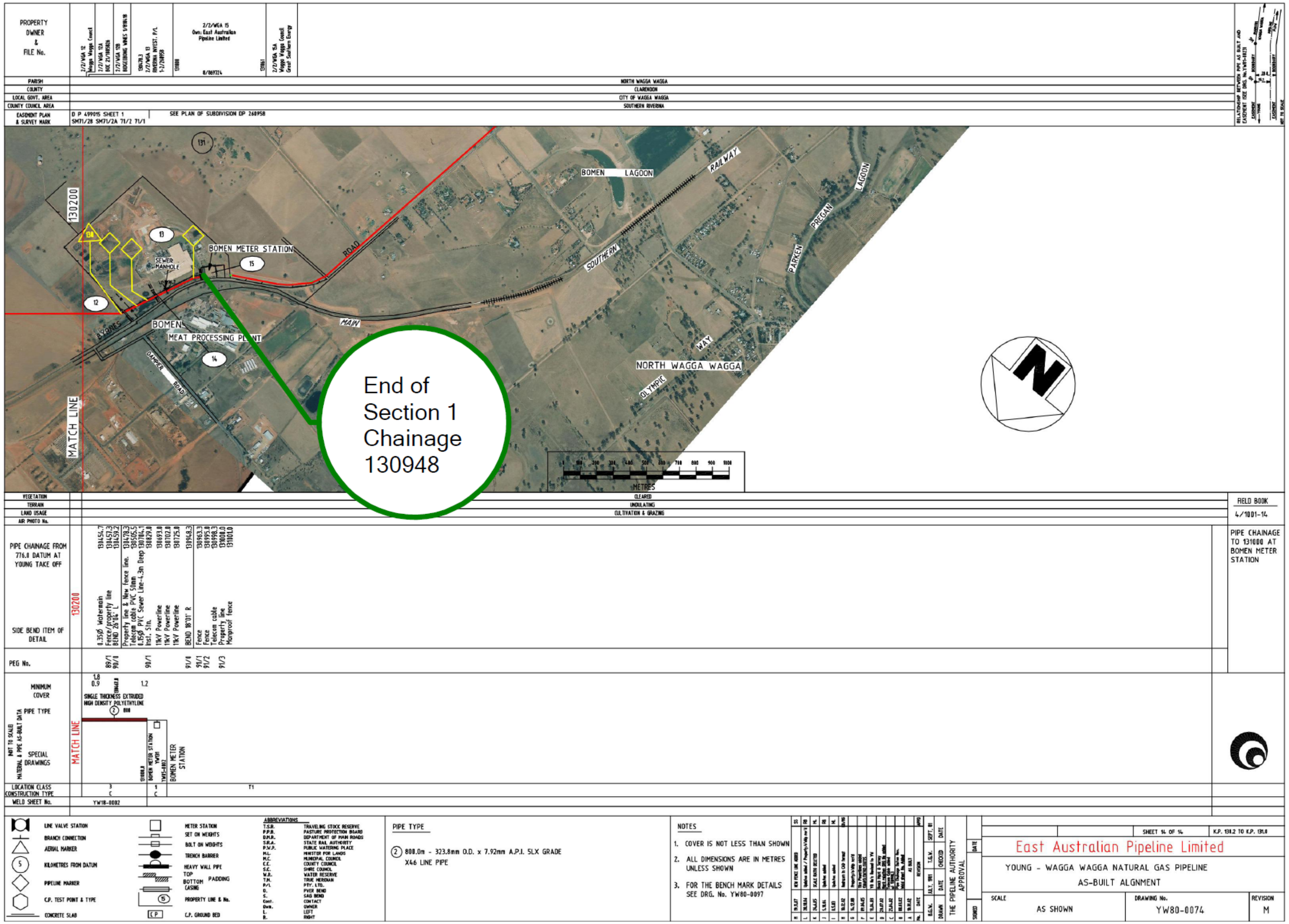
Sam Haddad
Director-General

Date: 16th April 2009.

Appendix C

APA Route Alignment Mapping


Start of Section 1 Chainage 70000
PROPERTY OWNER & FILE No.
PIPE CHAINAGE FROM 776.0 DATUM AT YOUNG TAKE OFF
SIDE BEND ITEM OF DETAIL
PEG No.
MINIMUM COVER
PIPE TYPE COATING
SPECIAL DRAWINGS
MATCH LINE
68900
79000
SINGLE THICKNESS EXTRUDED HIGH DENSITY POLYETHYLENE
FIELD BOOK 4/1001-14
PIPE CHAINAGE TO 131000 AT BOMEN METER STATION
PIPE TYPE
① 9919.8m – 323.8mm O.D. X 6.35mm A.P.I. 5LX GRADE X46 LINE PIPE
② 174.2m – 323.8mm O.D. X 7.92mm A.P.I. 5LX GRADE X46 LINE PIPE
NOTE: TYPE ② EXCLUSIVE OF BETHUNGRA LINE VALVE (6.0m)
NOTES
1. COVER IS NOT LESS THAN SHOWN
2. ALL DIMENSIONS ARE IN METRES UNLESS SHOWN
3. FOR THE BENCH MARK DETAILS SEE DRF. No. YW80-0097
East Australian Pipeline Limited
YOUNG - WAGGA WAGGA NATURAL GAS PIPELINE
AS-BUILT ALIGNMENT
SHEET 8 OF 14
K.P. 68.9 TO K.P. 79.0
SCALE AS SHOWN
DRAWING No. YW80-0068
REVISION 0

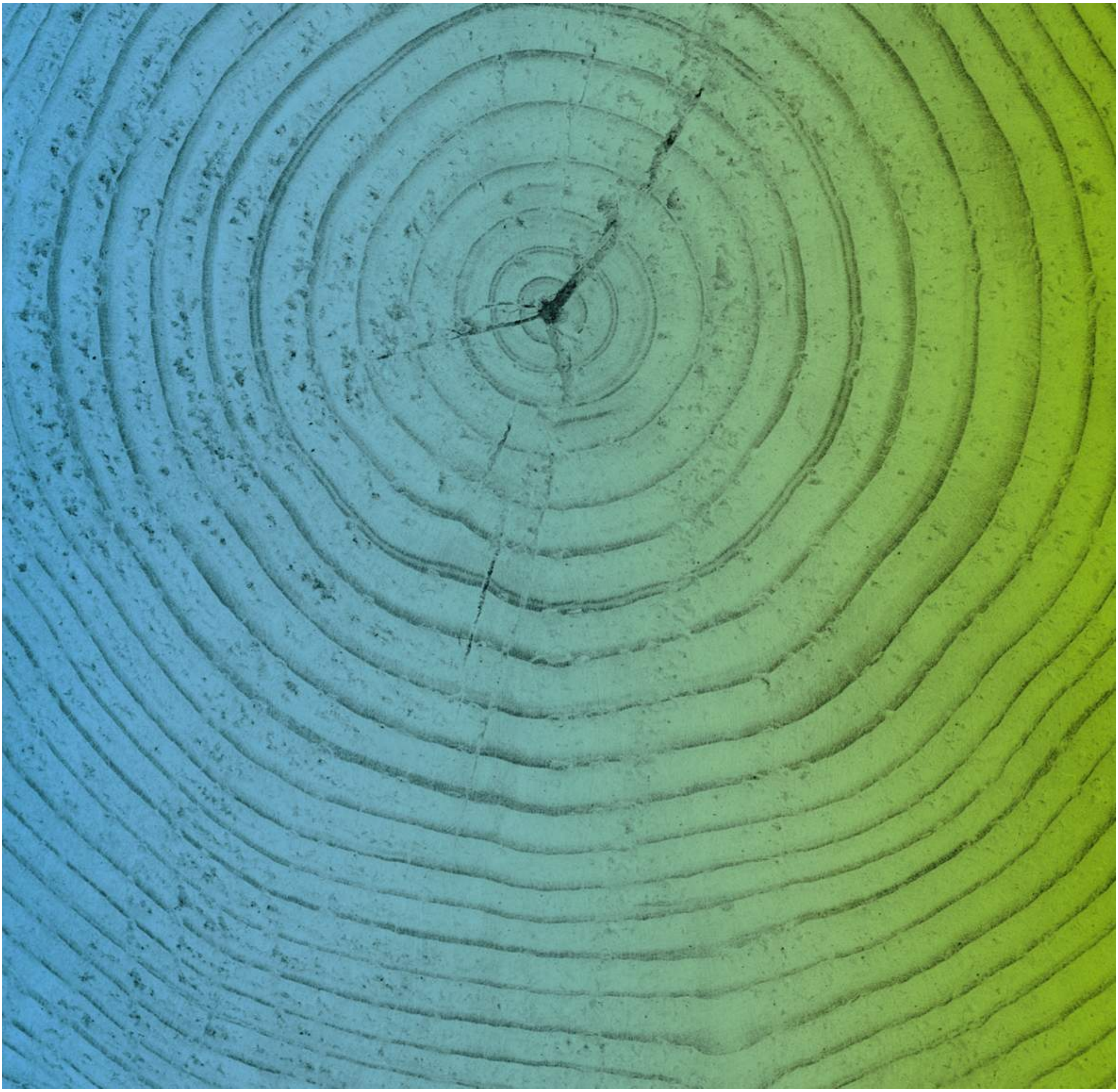

End of
Section 1
Chainage
130948
BOMEN LAGOON
RAILWAY
SOUTHERN
MAIN
BOMEN METER STATION
BOMEN
MEAT PROCESSING PLANT
NORTH WAGGA WAGGA
MATCH LINE
130200
PIPE CHAINAGE FROM 716.0 DATUM AT YOUNG TAKE OFF
PIPE CHAINAGE TO 131000 AT BOMEN METER STATION
VEGETATION CLEARED
TERRAIN UNDULATING
LAND USAGE CULTIVATION & GRAZING
NORTH WAGGA WAGGA
CLARENDON
CITY OF WAGGA WAGGA
SOUTHERN RIVERINA
NOTES
1. COVER IS NOT LESS THAN SHOWN
2. ALL DIMENSIONS ARE IN METRES UNLESS SHOWN
3. FOR THE BENCH MARK DETAILS SEE DRG. No. YW80-0097
PIPE TYPE
2 808.0m - 323.8mm O.D. x 7.92mm A.P.I. 5LX GRADE X46 LINE PIPE
East Australian Pipeline Limited
YOUNG - WAGGA WAGGA NATURAL GAS PIPELINE
AS-BUILT ALGNMENT
SCALE AS SHOWN
DRAWING No. YW80-0074
REVISION M

Appendix D

Flora and Fauna Assessment

Wagga to Young Gas Pipeline Upgrade

Flora and Fauna Assessment Report (Stage 1)



Wagga to Young Gas Pipeline Upgrade

Flora and Fauna Assessment Report (Stage 1)

Prepared for

APA Group

Prepared by

AECOM Australia Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

10/12/2009

Quality Information

Document Wagga to Young Gas Pipeline Upgrade

Ref

Date 10/12/2009

Prepared by David Armstrong and Paul Rossington

Reviewed by Dale Newsome

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	02/11/09	Preliminary (Not for Submission)	Dale Newsome Associate Director	
2	25/11/09	Internal review		
3	10/12/09	Final	Dale Newsome Associate Director	

Table of Contents

Executive Summary

This Flora and Fauna Assessment Report has been prepared to assess the construction and operation of Stage 1 (61 Km) (54 km of pipeline between Bethungra Line Valve and Bomen Meter Station) of a 131 km natural gas pipeline between the towns of Wagga Wagga and Young in the Upper Slopes subregion of the NSW South-West Slopes Bioregion . As shown in the APA drawings included in Appendix A, Stage 1 begins north of Bethungra (Chainage 70000) and ends north of Wagga, the Bowen Meter Station (Chainage 130948). Potential environmental impacts, including flora and fauna impacts represent a constraint to the construction of the works and were considered during the development of the construction methodology.

Two Four threatened bird species, the Superb Parrot Polytelis swainsoniiSwainsonii, and Brown Treecreeper Climacteris picumnus, White-browed Woodswallow Artamus superciliosus and the Barking Owl ninox connivens plus two threatened bat species Little Pied Bat Chalinolobus picatus and Eastern Bentwing-bat Miniopterus schreibersii oceanensis were recorded within the study area during the field survey. One threatened ecological community, Box Gum Woodland, was also recorded.

A variety of other threatened fauna species are considered to have potential to occur on the site on the basis of previous records and the characteristics of the habitats present on the site.

Whilst there is some potential for local occurrences of some threatened species and Box Gum Woodland to be impacted by the proposed works, the potential mitigation measures would ensure that impacts are minimised. Measures are also proposed to compensate for the disturbance to and loss of woodland habitat.

The project is not considered likely to cause a significant impact on the local occurrence of any threatened species, population or ecological community.

1.0 Introduction

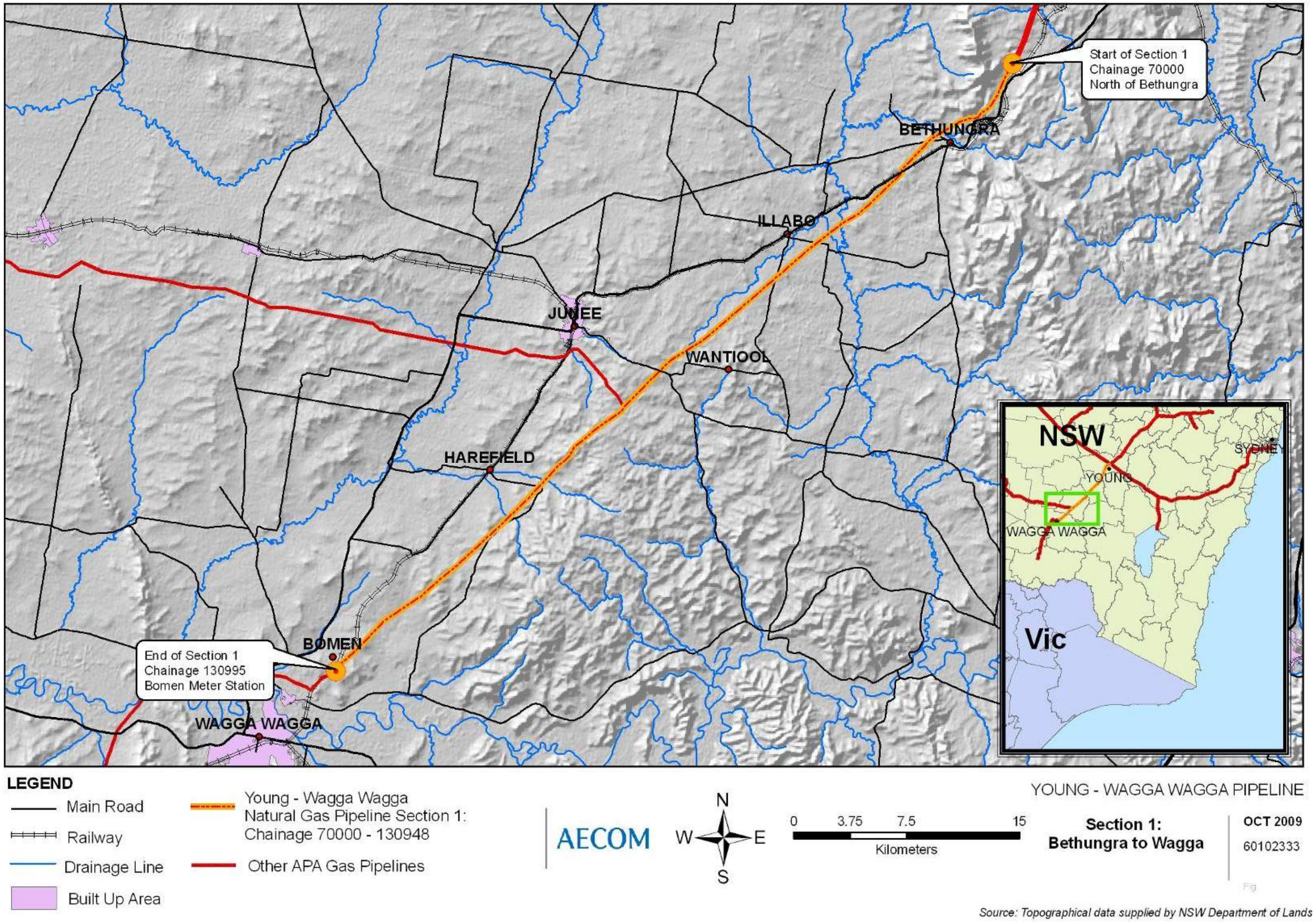
1.1 Background to the Study

East Australian Pipeline Pty Ltd (EAPL),) is proposing to loop (duplicate) the existing 12" Young to Wagga Wagga Pipeline with an 18" Pipeline.

On 4 July 2009, the Director-General's Environmental Assessment requirements were issued for the proposed project, pursuant to Section 75F(2) of the EP&A Act. The requirements reflect the project's 'major project' classification and are based on the information provided to date, including the Planning Focus Meeting held on 11 April 2009 and through consultation with relevant government agencies. An ecological assessment is required by the Director General's requirements:

This Flora and Fauna assessment report has been prepared as part of an Environmental Assessment under Part 3A of the Environmental Planning and Assessment Act 1979 and meets the specific requirements relating to ecological assessment of the project as prescribed by the Director General's requirements.

Locality of Section 1 of Young – Wagga natural gas pipeline



NOTE: Chainages provided by APA and sourced from “As-Built Alignment Drawing No. YW80-0068 through to YW80-007 (See Appendix A).

1.2 Objectives of the Flora and Flora Assessment

The objectives of the assessment are to:

- Identify the flora and fauna species present or potentially present within the study area,
- Determine if any species, population or ecological community would be significantly affected by the project,
- Recommend measures to minimise impacts on flora and fauna during construction and operation of the pipeline,
- Assess residual impacts on flora and fauna,
- Recommend measures to compensate for residual impacts on flora and fauna, and
- Recommend any additional assessment that may be required.

1.3 Legislative Requirements

The EP&A Act and EP&A Regulation 2000 provide the statutory context for assessment of the proposed works. The proposal is to be assessed under the provisions of Part 3A of the EP&A Act with the APA Group the proponent and the Department of Planning the consent authority.

The EP&A Act is supplemented by a number of Environmental Planning Instrument's (EPIs) including:

- State Environmental Planning Policies (SEPPs)
- Regional Environmental Plans (REPs)
- Local Environmental Plans (LEPs)
- Other planning policies and guidance statements.

Relevant legislation that applies to the project is described in the following sections.

1.4 NSW Legislation

1.4.1 Threatened Species Conservation Act 1995

The Threatened Species Conservation Act 1995 (TSC Act) outlines the protection of threatened species, communities and critical habitat in NSW. The Act is administered by the Department of Environment, Climate Change and Water (DECCW). Section 91 of the TSC Act requires that a license be obtained should a development result in one or more of the following:

- Harm to any animal that is of, or is part of, a threatened species, population or ecological community
- The picking of any plant that is of, or is part of, a threatened species, population or ecological community
- Damage to critical habitat
- Damage to habitat of a threatened species, population or ecological community.

1.4.2 Native Vegetation Act 2003

The Native Vegetation Act 2003 (NV Act) regulates the clearing of all native vegetation on land in NSW except land listed under Schedule 1 of the Act.

The objects of this NV Act are:

- to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State, and
- to prevent broadscale clearing unless it improves or maintains environmental outcomes, and
- to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation, and
- to improve the condition of existing native vegetation, particularly where it has high conservation value, and

• to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation, in accordance with the principles of ecologically sustainable development.

1.4.3 National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 (NPW Act) provides a framework to conserve native terrestrial flora and fauna species and manage areas of conservation value such as Nature Reserves.

Under this act, it is an offence to harm, trade, possess or damage critical habitat or the habitat of any threatened species without obtaining a Section 120 licence.

1.4.4 Noxious Weeds Act 1993

The Noxious Weeds Act 1993 (NW Act) establishes a system for the identification and control of noxious weeds in NSW. The Act divides noxious weeds into four categories which determine the level of control required. Responsibility for the control of noxious weeds lies with the owner and/or occupier of private land and Crown land, local councils and other public authorities on land they occupy. Under the NW Act, the Minister for Primary Industries may declare a plant to be a noxious weed. Control notices can be issued by the Minister and local control authorities to ensure obligations are met.

1.4.5 State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 (SEPP 44) encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range. The policy applies to 107 local government areas. Local councils cannot approve development in an area affected by the policy without an investigation of core koala habitat. The policy provides the state-wide approach needed to enable appropriate development to continue, while ensuring there is ongoing protection of koalas and their habitat.

The aim of SEPP 44 is 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". SEPP 44 applies to local government areas (LGAs) listed in Schedule 1. Of the LGAs within which the study area is located, only Wagga Wagga LGA is listed in Schedule 1. No stands of native vegetation exist within the section of the study area within Wagga Wagga LGA and hence the provisions of SEPP 44 do not apply to the project.

1.5 Commonwealth Legislation

1.5.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) governs the Commonwealth Environmental Assessment process and provides protection for matters of National Environmental Significance (NES), which include:

- Nationally threatened species and ecological communities
- Australia's World heritage properties
- Ramsar wetlands of international importance
- Migratory species listed under the EPBC Act (species protected under international agreements)
- Commonwealth marine areas
- Nuclear actions, including uranium mining
- National heritage.

The EPBC Act is separate from other approvals (such as those under the Threatened Species Conservation Act 1995).

2.0 Description of Study Area

The subject site is defined as the location of the proposed new pipeline, which will be located in an existing 20m easement, adjacent to an existing single line gas pipeline. A distance of approximately 10 m south-east of the pipeline easement is also likely to be substantially disturbed during construction. The width of likely disturbance varies with the nature of the works required and may be greater at portal locations for directional-drilling and under-boring.

The study area for the flora and fauna assessment includes the subject site and surrounding areas which may be indirectly affected by the proposal. The study area includes adjacent habitat areas which may be affected by impacts such as reduced connectivity or weed invasion. The entire subject site, as well those areas assessed in more detail, and study area are shown in Appendix F and Appendix G.

2.1 Topography, Geology and Soils

Topography

The land surface of the study area is characterised by undulating hills, open plains, alluvial flats and incised ephemeral waterways.

The landform within this landscape is characterised by gently undulating rises with broad crests and ridges and long gently inclined slopes.

Geology

Ordovician to Devonian folded and faulted sedimentary sequences with inter-bedded volcanic rocks and large areas of intrusive granites (Benson, 2008) characterises the geology of the region.

Soil

The soils of the region include shallow stony soils on steep slopes, texture contrast soils grading from red subsoils on upper slopes to yellow subsoils on lower slopes (Benson, 2008).

2.2 Land Use

Most of the study area is within areas characterised by rural land uses however it also includes short sections of road reservation. The land use over the vast majority of the study area is a combination of grazing on improved pastures and Lucerne (Medicago sativa) with some areas of cropping, particularly of Canola (Brassica napus).

2.3 Ecological Context

The study area is located within the Upper Slopes subregion of the Murrumbidgee Catchment Management Authority (CMA) region. The Upper Slopes subregion is within the NSW South-western Slopes Bioregion.

This bioregion has been subject to extensive clearing for agricultural activity which has left very little of the original woodland vegetation intact. Over 80% of the native vegetation in the region has been cleared making it the most cleared and fragmented of bioregion in NSW (Benson, 2008).

Outside conservation reserves, state forests, roadsides and travelling stock reserves, exotic plant species dominate the ground cover and native understorey shrub species and canopy regrowth are sparse or absent. At present less than 2% of the bioregion is protected in conservation reserves and only 28 of the 135 plant communities were assessed to be adequately protected in reserves (Benson, 2008).

Due to the small extent and fragmentation of native vegetation in the region, all areas of native vegetation which retain a substantial native species component in the groundcover and understorey layers are likely to have high conservation value, especially as habitat for fauna species. More disturbed habitats such as paddock trees and bands of trees along waterways may also have high conservation value where these are in close proximity to or connect more intact areas of vegetation.

3.0 Methodology

The assessment was undertaken in three (3) stages:

- Desktop investigation;
- Preliminary field reconnaissance; and
- Field survey.

3.1 Staff undertaking survey and assessment

The field survey, desktop investigations and impact assessment were conducted by David Armstrong and Paul Rossington.

Paul Rossington has completed a Bachelor of Science Degree, majoring in botany, zoology and ecology and a Post-graduate Diploma of Wildlife Management. David Armstrong has completed a Bachelor of Science (Resource & Environmental Management) and a Diploma of Environmental Science.

3.2 Seasonal and Weather Conditions

The weather conditions during the survey are described in Table 1 below.

Table 1 Seasonal and weather conditions

Date	Approximate temperature range (°C)	Wind (km/h)	Weather
29/09/09	5 -18	5 - 10	Fine
30/09/09	5 - 23	5 - 10	Fine
01/10/09	8 - 27	10 - 15	Fine
12/11/09	15 - 35	5 - 25	Fine

The seasonal and weather conditions during the field survey are considered to be conducive to the detection of many of the flora and fauna species targeted.

3.3 Desktop investigation

In order to identify all potential impacts of the project on flora and fauna, a review of existing information was conducted. This review included:

- searches of relevant biodiversity databases (DEC threatened species website, Atlas of NSW Wildlife, Bionet database & EPBC Protected Matters Search Tool),
- examination of available vegetation mapping (Keith Mapping (seek additional mapping for TSRs, PMPs, CMAs),
- examination of recent aerial photography,
- mapping of threatened species records for the study area, and
- research of literature of relevance to the key potential impacts

The results of this examination were used to categorise the different forms of habitat that appear to be present within the study area according to a number of variables including vegetation communities, vegetation condition, patch size, topography, and the presence of specific habitat features.

The DECCW threatened species profile of each locally recorded species was reviewed in order to determine which of these species have the potential to occur on the site based on habitat attributes present. Through this process a list of key threatened flora and fauna species and ecological communities hashave been identified for more detailed study.

Preliminary mapping of habitat features, vegetation and species records was used to guide the initial field reconnaissance and plan more detailed studies.

Based on the findings of the preliminary investigation, the following flora and fauna field survey effort was identified as necessary to inform the assessment of impacts on flora and fauna and to comply with the Director General's requirements for the Environmental Assessment.

3.4 Preliminary field reconnaissance

A preliminary site visit was conducted over a two day period. The preliminary reconnaissance was undertaken on sites selected during the desktop assessment that presented some potential to retain natural flora and fauna values. The preliminary reconnaissance to assess the habitat values of the area including the structure, condition and composition of vegetation communities present. The preliminary reconnaissance identified areas requiring detailed survey and targeted search for threatened flora species.

3.5 Field Survey

3.5.1 Flora Survey Methodology

Detailed field surveys include identification of all plant species located within the existing 30 metre pipeline easement of each site 20m x 20m flora survey plots and as well as a 1 person hour random meander search for threatened flora species in the surrounding vegetation. Each of the sites is shown in Appendix F.

For each survey plot, an estimate of the abundance of plant each species was recorded in order to describe the floristic structure, composition and condition of vegetation communities.

A total of 24 person hours was spent on flora field surveys. Plant species were identified with reference to Harden (1990-2000) and Botanic Gardens Trust (2009)

3.5.2 Flora Survey Locations

Given the limited extent of native vegetation apparent within the subject site and the limited extent of the proposed activities, a detailed field survey of flora species was considered necessary only in the select locations identified during the desktop assessment and preliminary reconnaissance. These locations are those in which native vegetation is retained in near-natural structure and composition such that a functioning vegetation community is present that is capable of supporting a moderate to high diversity of native plant species.

Within the study area such habitat is chiefly found within rarely grazed road reserves. Some native vegetation also remains in grazed land, of steeper terrain where the landform and rocky soils have discouraged vegetation clearing, cropping and pasture improvement,.

(Three sites), (Site 1 – Bethungra Mountain, Site 2 – Old Sydney Road to Ulandra Creek and Site 4 – Billabung Creek) One creek within the study area (Billabung Creek) also retains a moderate to high density tree canopy, though the understorey and ground layer vegetation in theseis locations is either disturbed or absent. No standing water or aquatic vegetation is was also apparent within the study area. The survey sites shown in Table 2, Appendix F and Appendix E were identified for more detailed assessment.

Table 2 Stage 1 Flora Survey Sites Identified for Detailed Assessment

Vegetation Survey Site Number	Location Description / Chainage	Canopy	Understorey	Ground Layer
1	Remnant Vegetation – Bethungra Mountain Chainage73000	Mature and semi-mature trees Mugga Iron Bark Grey Box	Scattered native understorey, Acacia spp.	Mix of native & exotic (chiefly native) spp.
2	Old Sydney Rd to Ulandra Creek Chainage 76722 - 77944	Mature and semi-mature trees Grey Box & White Cypress Pine grading into Yellow Box and River Red Gum	Few native shrubs	Mix of native & exotic spp. (chiefly native in non-arable land and road reserves and exotic in arable land).
3	Bethungra Line Valve Chainage 78130	Scattered mature trees Grey Box White Cypress Pine	Scattered native understorey, Acacia spp.	Mix of native & exotic (chiefly native) spp.

Vegetation Survey Site Number	Location Description / Chainage	Canopy	Understorey	Ground Layer
4	Billabung Creek Chainage 86040	Semi-mature trees & mature trees Red Gum	none	Mixed native & exotic (chiefly exotic) spp.
5	Illabo to Wantabadgery Rd Chainage 91634	Semi-mature trees to mature trees, White Box	Few native shrubs	Mix of native & exotic (chiefly native) spp.
6	Minor Road Chainage 95312	Juvenile to semi-mature trees White Box	none	Austrostipa and weeds
7	Gundagai Rd Chainage 101520	Semi-mature trees White Box	Acacia spp.	Mix of native & exotic spp. including herbs.
8	Vegetation on rocky rises in the vicinity of Chainage 108348	Scattered mature & semi mature trees Yellow Box Red Gum	none	Rock outcropping & few native species (e.g. Austrostipa & Lomandra spp.)

NOTE: Chainages and location names based on Young – Wagga Wagga Natural Gas Pipeline Drawings supplied by APA

3.5.3 Fauna Survey Methodology

During field reconnaissance, the study area was assessed as potential habitat for threatened fauna through observation and recording of key habitat features and characteristics including:

- preferred food plants,
- vegetation structure,
- mature, potentially hollow-bearing trees,
- fallen trees,
- rock outcrops,
- termite mounds, and
- water bodies

3.5.4 Fauna Survey Methodology

During field reconnaissance, the study area was assessed as potential habitat for threatened fauna through observation and recording of key habitat features and characteristics including:

- preferred food plants,
- vegetation structure,
- mature, potentially hollow-bearing trees,
- fallen trees,
- rock outcrops,
- termite mounds
- water bodies

A conservative approach was taken in the assessment of the potential of habitat for threatened fauna species and the results were used to determine which fauna survey techniques to utilise at specific locations within the study area. And overview of the fauna survey techniques is shown in Table 3.

Table 3 Fauna survey techniques used for each fauna group

Types of threatened fauna targeted	Survey techniques employed	Total Survey Effort
Woodland birds	Visual observation and call identification.	15 person hours
Nocturnal birds	Call playback,	8 sessions of 0.5 hour duration
	Spotlighting	20 person hours
Terrestrial and arboreal mammals	Spotlighting	20 person hours
	Call playback	8 sessions of 0.5 hour duration
	Hair and predator scat collection and analysis	100 hair tube nights 4 predator scats collected
Reptiles	Habitat searches for reptiles – lifting rocks, leaf litter and woody debris, inspection of fallen hollow logs	12 person hours
Bats	Anabat (ultrasonic bat call recording and analysis	18 recording hours
Frogs	Opportunistic call identification	Opportunistic during spotlighting
	Searches of sheltering habitat (concurrent with reptile searches)	12 person hours
All species	Habitat assessment. Search for feeding signs, scats, den sites, roosts etc.	10 person hours

3.5.5 Fauna Survey Locations

Given the limited extent of habitat available within the subject site and the extent of the proposed activities, a detailed field survey of fauna species was considered necessary only in select locations. These locations are those in which native vegetation is retained in near-natural structure and composition such that a structurally complex habitat remains that is capable of supporting a moderate to high diversity of native fauna species. These locations were the same as identified for the flora survey in Table 2 (Section 3.5.2).

4.0 Flora Results

4.1 Vegetation Overview

Regional Vegetation

The most widespread vegetation types in the region are White Box Grassy Woodlands and Blakely's red Gum – Yellow Box Grassy Woodland both of which are included under the Box Gum Woodland Endangered ecological community listing of the Threatened Species Conservation Act 1995. River Red Gum Tall Open Forest dominates major creeks whilst Mugga Iron Bark and Grey Box woodland occurs on the mid to upper slopes.

Vegetation of the Study Area

Most of the study area is subject to intensive rural land uses and vegetation is largely restricted to crop species (e.g. canola) and introduced pasture grasses (e.g. barley grasses Hordeum spp. and fescues Festuca spp.). Some grazed areas also contain patches of introduced grasses and herbaceous weeds interspersed with grazing tolerant native grasses (chiefly Speargrasses Austrostipa spp.). In some grazing areas on hillslopes which have shallow rocky soils, a few native plant species remain (chiefly Lomandra filiformis, Crassula sieberiana and Cheilanthes distans).

Isolated individuals of mature live and dead remnant eucalypts (chiefly White Box Eucalyptus albens, Yellow Box E. melliodora and Blakely's Red Gum E. blakeleyi), White Cypress Pines Callitris glaucophylla and Kurrajong Brachychiton populneus occur sporadically throughout the agricultural lands of the study area. Planted trees, chiefly Kurrajong, eucalypts and introduced species, occur as planted rows along some fence lines and minor roads.

The ephemeral waterways of the study area are denuded of native groundcover vegetation and do not support aquatic or wetland vegetation. One larger creek within the study area (Site 42, Billabung Creek) is lined by mature and regrowth River Red Gums whilst another (Bucks Creek) has been partially revegetated with native eucalypts and understorey shrubs which are presently immature.

The section which contains the largest area of remnant native vegetation, with a moderate to high diversity of native plant species, is located around the township of Bethungra. The vegetation is generally confined to the more elevated non-arable areas (Site 1) located on and immediately adjacent to the Bethungra Mountain area. However, there are significant areas (Site 2 & 3) of remnant vegetation located on the lower flats around Ulandra Creek (See Figure 5).

Of the remaining areas only areas containing a moderate to high diversity of native plant species are some road and travelling stock reserves areas contain a moderate to high diversity of native plant species. These areas contain a mosaic of native and introduced groundcover species and varying densities of shrubs and trees. White Box is the dominant tree in most of these locations.

Vegetation of the Survey Sites

A total of 68 78 plant species were recorded during flora surveys including 43 51 native species and 275 introduced species.

The vegetation composition at survey locations is shown in Table 4. Aerial and on ground photographs of these sites are included in Appendix F and Appendix E.

Table 4 Vegetation of the Survey Sites

Site	Figure in Appendix E	Location description	Canopy layer	Understorey	Groundcover
1	1	Bethungra Mountain	Mature and semi-mature trees Mugga Iron Bark Grey Box	Scattered native understorey, Acacia spp. Cassinia spp. Lissanthe spp	Mix of native & exotic (chiefly native) spp.
2	2	Old Sydney Rd to Ulandra Creek	Mature and semi-mature trees Grey Box & White Cypress Pine grading into Yellow Box and River Red Gum	Eucalypt and Cypress regrowth only	Mix of native & exotic spp. (chiefly native in non-arable land and road reserves and exotic in arable land).
3	3	Bethungra Line Valve	Single Callitris glaucophylla and juvenile Eucalyptus microcarpa.	none	Mixed introduced pasture grasses, native grasses (*Austrostipa* spp. and *Austrodanthonia* spp.) and exotic ground layer herbs – occasional native herbs e.g *Lomandra filiformis* and *Vittadinia cuneata*.
4	4	Illabo Rd	Open canopy of semi-mature to juvenile eucalypts - *chiefly E. albens* with *E. melliodora* occasional in adjacent areas	Sparse understorey of Acacia flexifolia and other Acacia spp. – other shrub species (*Dodonaea viscosa ssp. cuneata*, *Eutaxia microphylla* etc) in adjacent parts of road corridor	Mixed introduced pasture grasses, native grasses (*Austrostipa* spp., *Austrodanthonia* spp.) and native and exotic ground layer herbs.
5	5	Minor Road - Chainage 952	Semi-mature to juvenile eucalypts - chiefly post-fire basal regrowth of semi-mature trees - *E. albens*.	Eucalypt regrowth only.	Mixed introduced pasture grasses, native grasses (*Austrostipa* spp. and *Austrodanthonia* spp.) and exotic ground layer herbs – occasional native herbs e.g *Lomandra filiformis* and *Einadia nutans.*
6	6	Billabung Creek	Open canopy of mature to juvenile eucalypts - chiefly *E. camaldulensis* along creek edge with *E. melliodora* occasional in adjacent paddocks.	none	Introduced pasture grasses, and exotic ground layer herbs. Native species absent.
7	7	Gundagai Rd	Open canopy of semi-mature to	Sparse understorey and midstorey of	Mixed introduced pasture grasses,

Site	Figure in Appendix E	Location description	Canopy layer	Understorey	Groundcover
			juvenile eucalypts - chiefly *E. albens* with *E. melliodora* occasional in adjacent paddocks.	*Acacia implexa, A. deanei* and *A. buxifolia.*	*Austrostipa* spp. and native and exotic ground layer herbs e.g *Plantago varia*.
8	8	Rocky rises within grazing land	Occasional isolated individuals of mature eucalypts - *E. albens* and *E. melliodora*.	none	Mixed introduced pasture grasses, *Austrostipa spp*. and exotic ground layer herbs – occasional grazing tolerant native herbs – e.g. *Lomandra filiformis*.

Table 5 provides a summary of the condition of the vegetation at each of these sites.

Table 5 Vegetation Condition at Survey Sites

Site	Location description	Number of native species	Number of exotic species	Native ground layer species cover (%)	Vegetation condition
1	Bethungra Mountain	22	6	20	Medium to High
2	Old Sydney Rd to Ulandra Creek	14	12	30	Medium to Low
3	Bethungra Line Valve	12	9	30	Low to Medium
4	Illabo Rd	21	15	50	Medium
5	Minor Road - Chainage 952	17	12	40	Medium
6	Billabung Creek	1	7	0	Medium to Low
7	Gundagai Rd	23	11	65	Medium to High
8	Rocky rises within grazing land	9	9	20	Low

4.2 Threatened Flora

Searches of the NPWS Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool were conducted to determine if any threatened plant species listed under the TSC Act or EPBC Act are likely to occur in the vicinity. The database revealed that there are a number threatened species recorded in the vicinity of the site. An assessment of the likelihood of occurrence of these species based on previous records and habitat attributes is included in Appendix C and Appendix D. A summary of this assessment is shown in Table 6.

No threatened species were recorded during the field survey and based on a comparison of the known distribution and habitat characteristics of these species and the location and vegetation composition and condition of the study area, none of these species is considered to have a high likelihood of occurrence.

Two species have been identified as having a low to moderate potential to occur within the study area however these species are considered to have a low likelihood of occurrence within the areas directly impacted by the proposed works.

No population of any threatened plant species is considered likely to be affected by the proposed works.

Table 6 Threatened flora species recorded with likelihood of occurrence within the study area

Species Name	Status	Likelihood of Occurrence
Ammobium craspedioides Yass Daisy	Vulnerable (EPBC) Vulnerable (TSC)	Low to Moderate Near edge of species known distribution and not recorded during site investions.
Pilularia novae-hollandiae Austral Pillwort	Endangered (TSC)	Low Ephemeral waterways of the site do not appear to hold water for extended periods. Species not detected during field surveys.
Cullen parvum Small Scurf-pea	Endangered (TSC)	Low Very few records in region and species not detected during fireld surveys.
Euphrasia collina subsp. muelleri Mueller's Eyebright	Endangered (TSC) Endangered (EPBC)	Low Habitat within study area does not resemble the species' known habitat and and species not detected during fireld surveys.
Senecio garlandii Woolly Ragwort	Vulnerable (TSC) Vulnerable (EPBC)	Low No suitable habitat for this species within study area and species not detected during fireld surveys.
Swainsona sericea Silky Swainson-pea	Vulnerable (TSC)	Low to Moderate Potential habitat present however species not detected during fireld surveys.
Caladenia concolor Crimson Spider Orchid	Endangered (TSC) Endangered (EPBC)	Low No suitable habitat for this species within study area and species not detected during fireld surveys.
Diuris tricolour Pine Donkey Orchid	Vulnerable (TSC) Vulnerable (EPBC)	Low No suitable habitat for this species within study area and species not detected during fireld surveys.
Prasophyllum petilum Tarengo Leek Orchid	Endangered (TSC) Endangered (EPBC)	Low Species has not been recorded in the Upper Slopes subregion. The species is predicted to occur only east of Binalong in this subregion.
Grevillea wilkinsonii Tumut Grevillea	Endangered (TSC) Endangered (EPBC)	Low The distribution of the species is restricted to within 25 km of Tumut. No suitable habitat for this species within study area and species not detected during fireld surveys.
Pomaderris cotoneaster Cotoneaster Pomaderris	Endangered (TSC) Endangered (EPBC)	Low Species has not been recorded in the Upper Slopes subregion. The species is predicted to occur only east of Tumut in this subregion.No suitable habitat for this species within study area and species not detected during fireld surveys.
Pultenaea humilis Dwarf Bush Pea	Vulnerable (TSC)	Low to Moderate Species only recorded south of the Wagga Wagga district and not recorded during field surveys.

No threatened species were recorded during the field survey.

4.3 Threatened Ecological Communities

Searches of the DECCW threatened species website and EPBC Act Protected Matters Search Tool were conducted to determine if any threatened ecological communities listed under the TSC Act or EPBC Act are likely to occur in the vicinity. The database revealed that there are a number threatened ecological communities known from the region. An assessment of the presence of these species within the study area based on the plant species composition recorded during the flora survey is included in Appendix C and Appendix D. A summary of this assessment is shown in Table 7.

Table 7 Threatened Ecological Communities in the study area

Community Name	Status	Likelihood of Occurrence
Inland Grey Box Woodland in the Riverina; NSW South Western Slopes; Cobar Peneplain; Nandewar and Brigalow Belt South Bioregions	Endangered (TSC Act)	Low This community chiefly occurs west of the study area. A similar community recorded in the vicinity of the Bethungra Line Valve however this vegetation appears to be a variant (ID 267, Benson 2008) of Box Gum Woodland.
Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)	Not listed (TSC Act) Endangered (EPBC Act)	Low Habitat for the community restricted to Southern Tablelands section of the Upper slopes subregion. Vegetation community not recorded during site survey.
White Box Yellow Box Blakely's Red Gum Woodland	Endangered (TSC Act) Critically Endangered (EPBC Act)	High Vegetation community recorded at Site 2,3, 5, 6 and 7 in road reserves within the study area.

4.4 Noxious and Environmental Weeds

Four weed species that are declared as noxious weeds in the relevant weed control areas under the Noxious Weeds Act 1993 were recorded in parts of the study area (See Appendix B). These species and the relevant control requirements are shown in Table 8 below.

Table 8 Noxious Weeds

Scientific Name	Common Name	Control Class	Control Requirement
Marrubium vulgare	Horehound	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Echium plantagineum	Paterson's curse	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Rubus fruticosus	Black Berry	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Lycium ferocissimum	African Boxthorn	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority

A variety of environmental weeds that are not listed as noxious but contribute substantially to the degradation of native vegetation and threatened species habitat occur in the study area. The most prominent of these are the invasive pasture grass species, such as fescues Festuca spp. and barley grasses Hordeum spp. These species dominate disturbed ground and invade adjacent vegetation displacing native understorey vegetation and suppressing the germination of native plants.

5.0 Fauna Results

5.1 Fauna Habitat Characteristics of the Study Area

Potential habitat for a variety of fauna species exists within the remnant woodlands and rural landscape of the study area. The woodland of the study area provides a potential food source in the form of leaves, sap, nectar, pollen and seed for a number of bird, mammal and insect species. Threatened species which may use these resources include a variety of insectivorous woodland birds, nectar-feeding species such as the Swift Parrot Lathamus discolor and Regent Honeyeater Xanthomyza phrygia, the Squirrel Gilder Petaurus norfocensis and seed-eating birds such as the Superb Parrot Polytelis swainsonii.

Potential foraging habitat for a number of insectivorous bats (microbats) exists in the air spaces within and around the woodland areas.

Threatened predatory birds such as Ninox connivens (Barking Owl) and the Little Eagle Hieraaetus morphnoides were observed at one site and may hunt in other the areas of remnant woodland vegetation located within of the study area and nearby areas.

Most of the vegetation of the study area has been subject to previous clearing. The occasional mature trees within the study area may provide potential nest and roost sites for species of threatened hollow-dependent fauna which are capable of persisting in fragmented environments.

There is a considerable area of remnant vegetation located around the Bethungra HillsMountain area, located immediately north of Bethungra, which may provide substantial habitat values for a variety of native fauna species. The area may act as a base for a number of species, including migratory birds, to breed in whilst feeding in surrounding patches of isolated remnant vegetation such as that found at Site 1, 2 and 3.section...

The vegetation of the road corridors as well as the Ulandra andand Billabung Creeks may also act as movement corridors enabling fauna to move between populations located in larger areas of habitat within the region.

The specific habitat characteristics of the survey sites are shown in Table 9.

Table 9 Habitat Characteristics of the Survey Sites

Fauna Survey Site	Location Description / Chainage	Habitat Description
1	Bethungra Mountain – Remnant vegetation patch on mid-slope	Intact overstorey present providing habitat for a range of birds and mammals. Located relatively close to large expanse of high quality habitat within Bethungra Mountain.
2	Old Sydney Road to Ulandra Creek	Intact Box Gum overstorey present providing habitat for a range of birds and mammals. Located relatively close to large expanse of high quality habitat within Bethungra Mountain. No standing water.
3	Vicinity of Bethungra Line Valve	Habitat for woodland fauna present but fragmented and of narrow width. No aquatic habitat.
4	BILLABUNG CREEK 86040.8	Semi-mature trees & mature trees with potential for hollows. Ephemeral Creek with no standing water. No understorey. Exotic grass groundcover.
5	Illabo to Wantabadgery Rd 91634.1	Habitat for woodland fauna present but fragmented and of narrow width. No aquatic habitat.
6	Minor Road 95312.9	Habitat for woodland fauna present but fragmented and of narrow width. No aquatic habitat.

Fauna Survey Site	Location Description / Chainage	Habitat Description
7	MAIN ROAD No. 243 101520.9	Habitat for woodland fauna present but fragmented and of narrow width. No aquatic habitat.
8	Vegetation on rocky rises in the vicinity of 108348	Rocky habitat for reptiles present, however little native ground layer vegetation. Low to moderate canopy density. Only birds and highly mobile mammals (bats) considered to have potential to occur due to low canopy density. No aquatic habitat.

NOTE: Chainages and location names based on Young – Wagga Wagga Natural Gas Pipeline Drawings supplied by APA.

5.2 Fauna Recorded During Field Surveys

Fauna species recorded during the field survey comprised the following:

- 461 bird species (3 introduced)
- 6 terrestrial and arboreal mammal species (3 introduced, excluding domestic animals)
- 7 microchiropteran bat species (microbats)
- 65 reptile species (lizards), and
- 2 frog species.

Birds constituted the vast majority of the species recorded. Due to their mobility and ability to cope with habitat fragmentation, highly mobile native and introduced bird species typical of open environments and woodland clearings appear to dominate the feeding, nesting and roosting opportunities that exist within these habitats. Native bird species which appear to dominate in these areas include species such as the Noisy Miner Manorina melanocephala, Sulphur-crested Cockatoo Cacatua galerita, Galah Eolophus roseicapilla Australian Magpie Gymnorhina tibicen and Australian Raven Corvus coronoides.

Several of these bird species are believed to have increased markedly in their abundance as a result of human-induced changes to the environment and have been implicated in declines in species that are less tolerant of disturbed environments.

Despite the condition of the habitats in the study area a moderate diversity of woodland bird species remain apparent and several species of conservation significance were recorded. Bird species of conservation significance recorded during the field survey include:

- White-browed Woodswallow Artamus superciliosus (preliminary determination to list as Vulnerable under the TSC Act) at Site 75.
- Superb Parrot Polytelis swainsonii (Listed as Vulnerable under the TSC Act and EPBC Act) at Sites 42 and 53.
- Brown Treecreeper (Listed as Vulnerable under the TSC Act) at Site 2 & 42.
- Barking Owl Ninox connivens species name (# plus possible recordingbirdcall recordings) (Listed as Vulnerable under the TSC Act) at Site 2 (# Site 1 & 5).

Four native flightless mammal species, the Eastern Grey Kangaroo Macropus giganteus, Common Brushtail Possum Trichosurus vulpecula, Common Ringtail Possum Pseudocheirus peregrinus and Sugar Glider Petaurus breviceps were identified during the field survey. All of these species are capable of inhabiting moderately to highly disturbed environments. Brushtail and Common Ringtail Possums were abundant throughout Site 2 whilst Brushtail Possums are extremely abundant along Billabung Creek (Site 42) and the Common Ringtail Possum was abundant at Site 75. Sugar Gliders were observed in low numbers at Sites 42 and 75. These species are regarded as potential prey for the Barking Owl, which was observed at Site 2 and possibly heard at Site 1 & 7..

Seven species of microbats were observed. Two of these species, the Little Pied Bat Chalinolobus picatus and the Eastern Bentwing-bat Miniopterus schreibersii are listed as threatened species under the TSC Act. A species of large-eared bat (Nyctophilus spp.) was recorded, however, identification to species level was unable to be made as the calls of all three Nyctophilus species that occur in the bioregion overlap almost entirely in most characteristics.

Five reptile species (all lizards), Lace Monitor Varanus varius, South-eastern Morethia Skin Morethia boulengeri, Spiny-palmed snake-eyed skink Cryptoblepharus carnabyi , Eastern Striped Skink Ctenotus robustus and Olive Snake-lizard Delma inornata were observed. Two frog species, Spotted Marsh Frog Limnodynastes tasmaniensis and Beeping Froglet Crinia parinsignifera were heard calling from farm dams close to the study area. The total list of fauna species recorded during the site visit is shown in Appendix B.

5.3 Threatened Fauna

Searches of the NPWS Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool were conducted to determine if any threatened fauna species listed under the TSC Act or EPBC Act are likely to occur in the vicinity. The database revealed that there were a number of threatened species recorded in the vicinity of the site. The likelihood of occurrence in the ecology study area of these species based on previous records and habitat attributes is summarised in Appendix C and Appendix D. The species which are considered to have a moderate to high likelihood of utilising the habitats of the ecology study area are shown in Table 10. Two threatened fauna species were recorded in the study area during the site visit. The fauna species recorded during the site visit are shown in Appendix B and Appendix D.

Table 10 Table 10 Threatened fauna species with potential to occur in the study area

Common Name	Scientific Name	TSC Act Status	EPBC Act Status	Likelihood
Barking Owl	Ninox connivens	Vulnerable	n/a	Moderate to High Recorded at Site 2 and possibly heard at site 1. May breed, forage and shelter around the Bethungra Hills area May breed, forage and shelter in the vicinity of Billabung Creek and may also forage in nearby road reserves.
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	Vulnerable	n/a	High Recorded on site in highly disturbed River Red Gum forest along Site 4 - Billabung Creek.
Diamond Firetail	Stagonopleura guttata	Vulnerable	n/a	Moderate Vegetation patches of the study area are small, linear and fragmented.
Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	Vulnerable	n/a	High Recorded in study area Maternity colonies unlikely
Flame Robin	Petroica phoenicea	Vulnerable (preliminary determination)	n/a	Moderate
Gang-gang Cockatoo	Callocephalon fimbriatum	Vulnerable	n/a	Moderate May forage in area during winter but unlikely to occur at other times or breed in area.

Common Name	Scientific Name	TSC Act Status	EPBC Act Status	Likelihood
Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	Vulnerable	n/a	Moderate Vegetation patches of the study area are small, linear and fragmented.
Little Eagle	Hieraaetus morphnoides	Vulnerable (preliminary determination)	n/a	High
Little Lorikeet	Glossopsitta pusilla	Vulnerable	n/a	Moderate to High Vegetation patches of the study area are small, linear and fragmented however this species may persist.
Little Pied Bat	Chalinolobus picatus	Vulnerable	n/a	High Recorded in study area
Regent Honeyeater	Xanthomyza phrygia	Endangered	Endangered	High to Moderate Vegetation patches of the study area are small, linear and fragmented and vegetation cover is low. Likely only to be occasional foraging habitat.
Scarlet Robin	Petroica multicolor	Vulnerable (preliminary determination)	n/a	Moderate
Spotted Harrier	Circus assimilis	Vulnerable (preliminary determination	n/a	Moderate Vegetation patches of the study area are small, linear and fragmented and may not be sufficient to support a population of this species.
Square-tailed Kite	Lophoictinia isura	Vulnerable	n/a	Moderate Vegetation patches of the study area are small, linear and fragmented and may not be sufficient to support a population of this species.
Squirrel Glider	Petaurus norfolcensis	Vulnerable	n/a	Moderate Few records of species in the vicinity of study area. Potential habitat exists in road reserves and adjacent paddock trees.

Common Name	Scientific Name	TSC Act Status	EPBC Act Status	Likelihood
Striped Legless Lizard	Delma impar	Vulnerable	Vulnerable	Moderate Marginal habitat in the form of disturbed open Box-Gum Woodland present in the study area.
Superb Parrot	Polytelis swainsonii	Vulnerable	Vulnerable	High Recorded at Site 2 (Billabung Creek) and Site 3 (Illabo) where feeding and breeding may occur in hollow bearing trees**Error! Reference source not found.**.
Swift Parrot	Lathamus discolor	Endangered	Endangered	Moderate to High Vegetation patches of the study area are small, linear and fragmented and vegetation cover is low. Likely only to be occasional foraging habitat.
Turquoise Parrot	Neophema pulchella	Vulnerable	n/a	Moderate Vegetation patches of the study area are small, linear and fragmented however this species may persist.
Varied Sitella	Daphoenositta chrysoptera	Vulnerable (preliminary determination	n/a	Moderate Vegetation patches of the study area are small, linear and fragmented however this species may persist.
White-browed Woodswallow	Artamus superciliosus	Vulnerable (preliminary determination)	n/a	High Recorded on Site 7
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	Vulnerable	n/a	Moderate

5.4 Migratory Fauna Listed Under Commonwealth Legislation

The EPBC Act search showed that 14 migratory terrestrial, wetland and marine species protected under the Act are likely to occur in the area. Of these, only the following terrestrial species are considered to have potential to occur on the site due to the lack of aquatic habitat present:

- Hirundapus caudacutus (White-throated Needletail),
- Merops ornatus (Rainbow Bee-eater),
- Lathamus discolor (Swift Parrot)
- Xanthomyza phrygia (Regent Honeyeater), and

The Swift Parrot is only known to breed in Tasmania and the Regent Honeyeater is a nomadic species which is only known to breed in two areas within NSW (DECCW 2009). Potential breeding habitat for this species is absent from the study area. Rainbow Bee-eaters nest in earth banks with southern populations tending to move north to breed (Australian Museum and Birds Australia 2007).

White-throated Needletails are non-breeding migrants in Australia with breeding occuring in northern Asia (Australian Museum and Birds Australia 2007). Due to the lack of suitable breeding habitat, none of these species are considered likely to breed in the study area, however, they may forage within the habitats found on a sporadic or regular seasonal basis.

6.0 Impact Assessment

6.1 Key Threatening Processes

The following TSC Act listed key threatening processes are likely to affect the flora and fauna of the locality:

- Invasion of native plant communities by exotic perennial grasses
- Competition and grazing by the feral European rabbit
- Competition from feral honeybees
- Predation by feral cats
- Predation by the European Red Fox
- Clearing of native vegetation
- Loss of Hollow-bearing Trees - key threatening process
- Removal of dead wood and dead trees
- Infection by Psittacine circoviral (beak & feather) disease affecting endangered psittacine species

The potential effect of the proposal on these processes is described in Table 11.

Table 11 Effect of the Project on Key Threatening Processes

Key Threatening Processes	Relevance to Study Area	Potential Impact of Project	Mitigation
Invasion of native plant communities by exotic perennial grasses	The native plant communities that exist in the road reserves of the study area are moderately to heavily affect by invading exotic perennial pasture grasses.	The project has potential to create favorable conditions for the proliferation of exotic plant species through disturbance of groundcover vegetation and soil disturbance.	Rehabilitation of disturbed areas within road reserves (those containing native vegetation communities) would be undertaken using native groundcover species to maintain or improve the current condition of vegetation in these locations.
Competition and grazing by the feral European rabbit	The feral European rabbit is abundant within the study area and is likely to be contributing to the degradation of native vegetation communities.	The project is unlikely to have any impact on the abundance or impact of the feral European rabbit.	Measures will be required to protect re-establishing ground layer vegetation from excessive rabbit damage.
Competition from feral honeybees	Feral honeybees are likely to compete with native fauna for hollows, nectar and pollen resources.	The pipeline installation is unlikely to have any impact on the abundance or impact of feral honeybees. Any nest boxes installed may be attractive to feral honeybees.	Any nest boxes installed as part of the project will be designed to minimize the likelihood of their use by feral honeybees.
Predation by feral cats	Feral cats may be present within the study area and may have contributed to impacts on small native fauna species.	The project is unlikely to have any impact on the abundance or impact of feral cats.	none
Predation by the European Red Fox	The European Red Fox is present within the study area and is likely to have contributed to local extinction of small native fauna species.	The project is unlikely to have any impact on the abundance or impact of The European Red Fox.	none

Key Threatening Processes	Relevance to Study Area	Potential Impact of Project	Mitigation
Clearing of native vegetation	The study area is largely cleared with native vegetation communities only persisting within road reserves. The area most likely to require the most clearing of mature eucalypt trees occurs around Site 2.	The proposed works would require the clearing of approximately 4.0 hectares of native vegetation within road reserves and the removal of approximately 50 isolated paddock trees. An area of approximately 3.0 hectares of remnant vegetation located around Site 2 will likely be removed by the proposed works. However, as this area occurs within a larger area of vegetation, impacts are expected to be minimal	Road reserve native vegetation - The minimum practicable clearing of native vegetation would be conducted for the construction and operation of the works. Native groundcover vegetation would be re-established where the route crosses road reserves containing native vegetation communities. Planting of native tree and shrub species would also be conducted in nearby open areas within the road reserves to replace those removed.
Loss of Hollow-bearing Trees - key threatening process	Hollow-bearing trees are likely to be a resource that limits the population of hollow-dependent fauna species in the study area due to: the largely cleared landscape , the lack of on farm regeneration to replace ongoing losses of due to tree senescence and dieback	The proposed works will involve the removal of several hollow bearing trees located within Site 2, especially alongside Ulandra Creek as well as two hollow-bearing trees within the road reserve at Site 5. Some of the approximately 50 isolated paddock trees likely to be removed may also be hollow-bearing.	The minimum practicable clearing of mature and hollow-bearing trees would be conducted for the construction and operation of the works. The hollows would be removed within the road reserves would be attached to healthy, mature trees (*Eucalyptus* spp.) nearby within the road reserve under the direction of an ecologist.
Removal of dead wood and dead trees	The removal of dead wood and dead trees (firewood collection) is evident within the road reserves of the study area.	The proposed works will involve the removal of fallen timber and several dead standing trees within road reserves and grazing lands.	Under the direction of an ecologist, dead woody debris cleared for the works and larger branches and root balls from living felled trees would be relocated to open areas within native vegetation communities in road reservations to provide habitat for native fauna.
Infection by Psittacine circoviral (beak & feather) disease affecting endangered psittacine species	This naturally occurring disease is likely to exist within the study area and may affect the breeding success of the threatened Superb Parrot.	The project is unlikely to have any impact on the occurrence or impact of this disease.	none

6.2 Critical Habitat

No critical habitat listed under the TSC Act or EPBC Act for any species, populating or ecological community exists within or adjacent to the study area. No impacts on critical habitat are anticipated.

6.3 Impacts on vegetation and flora species

Impacts on native vegetation communities are restricted to the passing through the area of remnant woodland at Site 1 – Bethungra Mountain and the crossing of Site 4 - Billiabung Creek identified in Appendix E. An area of approximately 2.0 hectares of Mugga Iron Bark Inland Grey Box tall woodland (ID 217 in Benson 2008) which contains several mature eucalypts as well as a considerable understorey and ground storey is proposed to be removed at the Bethungra Mountain site. An area of less than 0.01 hectares of highly disturbed riparian River Red Gum Woodland/Forest (ID 79 in Benson 2008) which is devoid of native understorey or groundcover is proposed to be removed at Billiabung Creek. A total of approximately 50 isolated remnant paddock trees and planted trees along fencelines and tracks throughout the length of the pipeline may also be removed.

Vegetation consistent with the definition of the threatened White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland) ecological community (ID 266, Benson 2008) would be disturbed at fivefour (54) road crossing sites resulting in a total area of approximately 0.64.0 hectares of this community being affected. Clearing within the Box Gum Woodland community would include the removal of approximately twenty semi-mature to mature trees. A more detailed assessment of impacts on this community is provided in Appendix D and Appendix EAppendix D. As described in Section 9.

Theis impact to mature trees on Site 3, 5, 6 & 7 will be avoided by the amendment of the construction method at these crossings to thrust boring rather than open trench. Due to the considerable extent of the area of Box Gum woodland located at Site 2, particularly in the southern quarter near the old Sydney Road, these construction methods are not likely to be feasible. However, there is an extremely large, hollow-bearing River Red Gum tree located directly in line with the proposed pipeline alongside Ulandra Creek (See Error! Reference source not found. & Figure 8), which may be able to be avoided through suitable construction techniques.

The understorey and groundcover of the Box Gum Woodland within the road reserves is moderately disturbed consisting of a mosaic of areas dominated by native grasses, herbs and low shrub species and areas dominated by exotic pasture grasses and herbaceous annual and perennial weeds.

Much of the ground layer of the Box Gum Woodland at the road crossings that would be affected by the new pipeline is dominated by exotic species, likely due to the disturbance created during the installation of the existing pipeline.

No threatened flora species were recorded within the study area and none were considered likely to occur here due to a lack of suitable habitat and no impacts on any threatened flora species are considered likely to occur.

6.4 Impacts on fauna species and habitat

Impacts on native fauna habitat would be almost entirely restricted to the road crossings identified in Appendix E and the crossing of Ulandra and Billabung Creeks. Mature trees that may form habitat for highly mobile and disturbance-tolerant native fauna species (e.g. some bat and bird species) is also likely to be affected in the cleared farmland within the study area. Where these trees are located within several hundred metres of woodland patches, they may be utilised by some less disturbance tolerant threatened fauna species such as the Superb Parrot Polytelis swainsonii and hollow-dependent bat species such as the Little Pied Bat Chalinolobus picatus.

The Box Gum Woodland that would be removed at the road crossings, as well as the larger area located near Old Sydney Road within Site 2, is also habitat for these species and may also provide habitat for fauna species which require greater tree cover and understorey vegetation including a number of threatened and migratory woodland birds and mammals such as the Brown Treecreeper Climacteris picumnus victoriae, Turquoise Parrot Neophema pulchella and Squirrel Glider Petaurus norfolcensis. The NSW Scientific Committee has recently made preliminary determinations to list a number of additional woodland bird species as threatened species under the TSC Act. The Box Gum Woodland of the study area is also potential habitat for these species.

The vegetation removal on the site is not considered likely to significantly affect the value of this habitat as a foraging resource for any threatened fauna species due to the:

- small amount of vegetation removed in each crossing location,
- naturally open structure of the woodland,
- proposed replanting of groundcover vegetation, and
- proposed relocation of woody debris and felled trees to nearby locations within the road reserve.

The gaps created in the vegetation at the crossings are not considered to be wide enough to significantly impede the movement of native fauna or to substantially increase habitat fragmentation.

Opportunities for nesting within the understorey of the Box Gum Woodland may be temporarily reduced, however the extent of understorey removal is small and the proposed planting of understorey vegetation in adjacent areas will supplement the remaining habitat.

Tree hollows chiefly form in mature trees which are in excess of 150 years old (NSW Scientific Committee 2007) and hence take a long time to be replaced once lost. In the highly cleared landscape within which the study area is located, mature trees are relatively scarce and competition from increasingly abundant native hollow-dependent species (e.g. Galahs) and introduced species (e.g. European Starling and feral European honeybees) for nesting opportunities is likely to be intense. The scarcity of tree hollows may limit the breeding success of several threatened fauna species. The removal of hollow-bearing trees and mature to semi-mature trees (potential future hollow-bearing trees) within road reservations would have the most impact on fauna species of any aspect of the works. The two hollow-bearing trees within the road reserve at Site 53 which would be removed showed signs of utilisation by parrots and appear to be of a size and in a location that may make them suitable as nesting site for the Superb Parrot.

A more detailed assessment of impacts on threatened and migratory fauna species likely to utilise the habitats within the study area is provided in Appendix C, Appendix D and Appendix E.

7.0 Recommended Mitigation Measures

The following mitigation measures are described in the Environmental Assessment to be submitted to the Department of Planning for approval and would be detailed in the Vegetation and Fauna Management section of the CEMP.

- The minimum practicable clearing of native vegetation to be conducted for the construction and operation of the works.
- Temporary fencing to be placed between areas containing native vegetation to be retained to exclude earthworks
- Rehabilitation of disturbed areas within road reserves (those containing native vegetation communities) to be undertaken by suitably qualified and experienced staff using local provenance plant species indigenous to the vegetation communities of the study area to maintain or improve the current condition of vegetation in these locations. Within the easement, rehabilitation would be restricted to the installation of weed-free mulch and the planting of native grasses and other native groundcover vegetation. Planting of native tree and shrub species would also be conducted in nearby open areas within the road reserves to replace those removed.
- Compensatory tree planting at Billabung Creek and Bucks Creek would be conducted in consultation with landowners to replace the trees lost in these locations.
- Replanted native vegetation to be protected from excessive rabbit damage and other herbivores using temporary fencing, tree guards or other suitable techniques.
- Removal of the hollow-bearing trees located within the Old Sydney Road to Ulandra Creek area (76722 – 77944km) as well as within the road reserve near Illabo meter station (91634.1 km) to be avoided if practicable. If the trees need to be removed, all of the hollows within the trees are to be removed and attached to healthy, mature trees (Eucalyptus spp.) nearby within the road reserve under the direction of an ecologist. If relocation of hollows is not feasible or hollows are damaged during tree felling, nest boxes suitable for nesting by the Superb Parrot would be installed to replace these hollows.
- Site 2 Massive Trees
- The banks of the dry waterways crossed by the works would be stabilized to prevent erosion.
- All trees in excess of 150 mm diameter requiring removal are to be placed with regard to the existing vegetation to nearby areas within road reserves or riparian areas to provide habitat for native fauna. Woody debris cleared for the works would also be relocated.
- Saplings and shrubs to be mulched for use in revegetation and soil stabilisation during rehabilitation.
- Earth-working equipment would be cleaned of excess soil by brushing or hosing prior to arrival and departure from each of the road reserves containing Box Gum Woodland to minimise the likelihood of the spread of weed seeds and plant pathogens.
- If the pipeline is to be constructed during Spring or Summer (which are likely to be the peak breeding periods of threatened bird and bat species), any trees which would not require immediate removal for construction (yet would need to be removed to prevent future damage due to root growth) would be removed during Autumn.
- All trees requiring removal for the works should be felled at least 48 hours prior to their removal from the pipeline easement to allow and fauna utilising these trees to relocate.

8.0 References

Australian Museum and Birds Australia 2007 Birds in Backyards. Website owned and managed through a partnership between Birds Australia and the Australian Museum.

Benson 2008 New South Wales Vegetation Classification and Assessment: Part 2 Plant communities of the NSW South-western Slopes Bioregion and update of NSW Western Plains plant communities, Version 2 of the NSWVCA database Cunninghamia 10(4): 2008

Botanic Gardens Trust 2009 PlantNET - The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (version [number]). http://plantnet.rbgsyd.nsw.gov.au

DECCW 2009 Threatened species, populations and ecological communities of NSW – Species ProfilesThreats. Threatened Species Website http://www.threatenedspecies.environment.nsw.gov.au/index.aspx NSW Department of Environment and Climate Change.

DECCW 2009 Threatened species, populations and ecological communities of NSW – Species Profiles. Threatened Species Website http://www.threatenedspecies.environment.nsw.gov.au/index.aspx

NSW Department of Environment and Climate Change.

DEWR 2009 Species Profile and Threats Database Australian Government Department of the Environment, Water, Heritage and the Arts http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

EPBC Act policy statement 3.5 - White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands

Harden, 1990-2000 Flora of New South Wales Volumes 1-4 (New South Wales University Press: Sydney).

Lands 2007 Topographic maps (Current Series) NSW Department of Lands SIX Viewer, six.maps.nsw.gov.au

NSW National Parks and Wildlife Service Identification Guidelines for Endangered Ecological Communities: White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland) NSW Government

NSW Scientific Committee 2007 Loss of Hollow-bearing Trees - key threatening process determination (independent Scientific Committee established under the Threatened Species Conservation Act 1995)

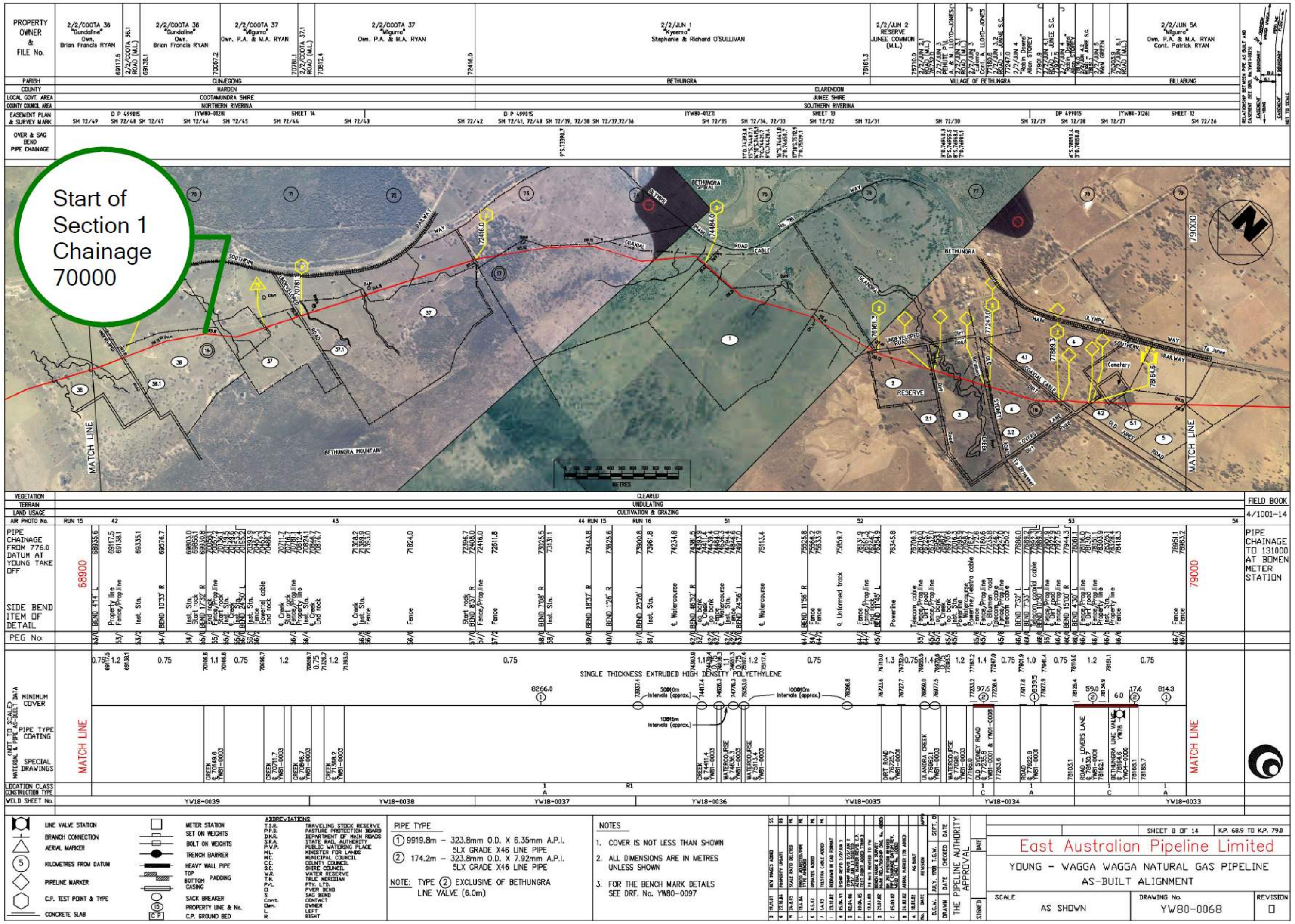
PlantNET FloraOnline 2008 Botanic Gardens Trust (12/01/09). PlantNET - The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (Version 2.0) http://plantnet.rbgsyd.nsw.gov.au.

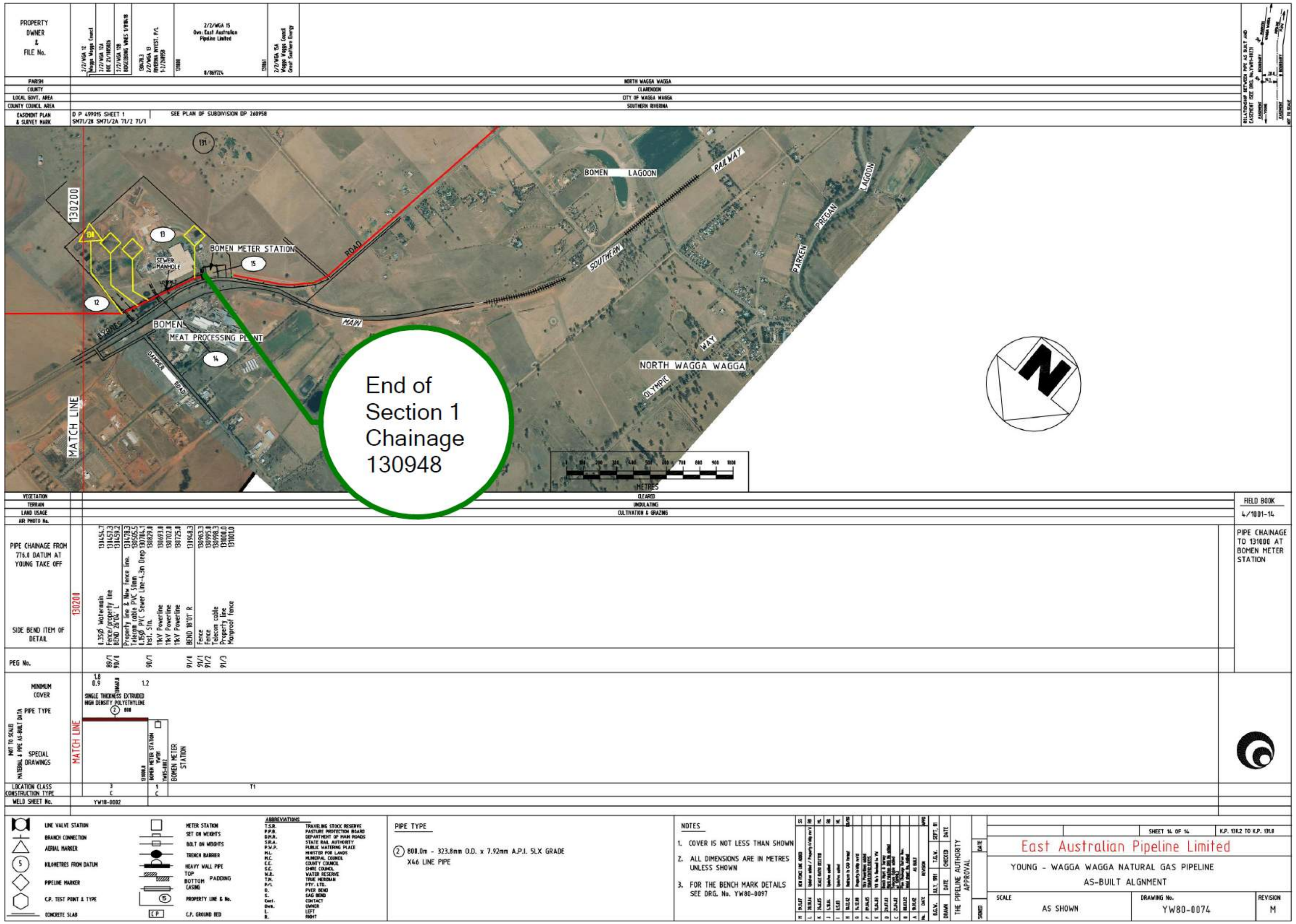
9.0 Appendices

Appendix A Study Area

Appendix A Study Area

Sheet 1 and 8 of Young – Wagga Wagga Natural Gas Pipeline As-built Alignment (Source: APA). Start and End of study area indicated.




End of
Section 1
Chainage
130948
BOMEN LAGOON
BOMEN METER STATION
BOMEN
MEAT PROCESSING PLANT
NORTH WAGGA WAGGA
MATCH LINE
130200
East Australian Pipeline Limited
YOUNG - WAGGA WAGGA NATURAL GAS PIPELINE
AS-BUILT ALIGNMENT
AS SHOWN
YW80-0074

Appendix B Flora and Fauna Inventories

Appendix B Flora and Fauna Inventories

Table 12 Fauna species recorded during survey

Common Name	Scientific Name	Comment	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 3 Bethungra Valve Station	Site 4 Billabung Creek	Site 5 Illabo Road	Site 6 Gravel Road	Site 7 Gundagai Rd	Site 8 Rocky Outcrop
Apostlebird	Struthidea cinerea									
Australian Magpie	Gymnorhina tibicen									
Australian Raven	Corvus coronoides									
Barking Owl	Ninox connivens	# possible bird call heard	#			#				
Black-faced Cuckoo-shrike	Coracina novaehollandiae									
Black-shouldered Kite	Elanus axillaris									
Brown Falcon	Falco berigora									
Brown Goshawk	Accipiter fasciatus									
Brown Songlark	Cincloramphus cruralis									
Brown Thornbill	*Acanthiza pusilla*									
Brown Treecreeper	Climacteris picumnus									
Cockatiel	Nymphicus hollandicus									
Common Starling*	Sturnus vulgaris									
Crested Pigeon	Ocyphaps lophotes									

Common Name	Scientific Name	Comment	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 3 Bethungra Valve Station	Site 4 Billabung Creek	Site 5 Illabo Road	Site 6 Gravel Road	Site 7 Gundagai Rd	Site 8 Rocky Outcrop
Eastern Rosella	Platycercus eximius									
Galah	Eolophus roseicapilla									
Grey Butcherbird	*Cracticus torquatus*									
Grey Fantail	Rhipidura fuliginosa									
House Sparrow*	Passer domesticus									
Laughing Kookaburra	Dacelo novaeguineae									
Little Corella	Cacatua sanguinea									
Little Grassbird	Megalurus gramineus									
Magpie-lark	Grallina cyanoleuca									
Nankeen Kestrel	Falco cenchroides									
Noisy Miner	Manorina melanocephala									
Pacific Black Duck	Anas superciliosa									
Pied Currawong	*Strepera graculina*									

Common Name	Scientific Name	Comment	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 3 Bethungra Valve Station	Site 4 Billabung Creek	Site 5 Illabo Road	Site 6 Gravel Road	Site 7 Gundagai Rd	Site 8 Rocky Outcrop
Pied Butcherbird	Cracticus nigrogularis									
Red-capped Robin	Petroica goodenovii									
Red-rumped Parrot	Psephotus haematonotus									
Rock Dove*	Columba livia	*								
Striated Pardalote	Pardalotus striatus									
Sulphur-crested Cockatoo	Cacatua galerita									
Superb Fairy-wren	Malurus cyaneus									
Superb Parrot	Polytelis swainsonii	Flying overhead and landing in trees								
Tawny Frogmouth	Podargus strigoides									
Wedge-tailed Eagle	Aquila audax									
Welcome Swallow	Hirundo neoxena									
Whistling Kite	Haliastur sphenurus									
White-browed Woodswallow	Artamus superciliosus	Approx. 10 roosting								

Common Name	Scientific Name	Comment	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 3 Bethungra Valve Station	Site 4 Billabung Creek	Site 5 Illabo Road	Site 6 Gravel Road	Site 7 Gundagai Rd	Site 8 Rocky Outcrop
White-browed Treecreeper	*Climacteris affinis*									
White-faced Heron	Egretta novaehollandiae									
White-necked Heron	*Ardea pacifica*									
White-winged Chough	Corcorax melanorhamphos									
Willie Wagtail	Rhipidura leucophrys									
Yellow Thornbill	Acanthiza nana									
Eastern Bearded Dragon	Pogona Barbata									
Common Brushtail Possum	Trichosurus vulpecula									
Common Ringtail Possum	Pseudocheirus peregrinus									
Eastern Grey Kangaroo	Macropus giganteus									
European Red Fox	Vulpes vulpes									
Brown Hare	Lepus capensis									
European Rabbit	Oryctolagus cuniculus									
Sugar Glider	Petaurus breviceps									
Sugar or Squirrel Glider	Petaurus sp.	poor view – probable *P.*								

Common Name	Scientific Name	Comment	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 3 Bethungra Valve Station	Site 4 Billabung Creek	Site 5 Illabo Road	Site 6 Gravel Road	Site 7 Gundagai Rd	Site 8 Rocky Outcrop
		breviceps								
Gould's Wattled Bat	Chalinolobus gouldii	definite								
Little Pied Bat	Chalinolobus picatus	definite								
Little Forest Bat	Vespadelus vulturnus	probable								
Eastern Bentwing-bat	Miniopterus schreibersii	definite								
Chocolate Wattled Bat	Chalinolobus morio	definite								
Inland Broad-nosed Bat	Scotorepens balstoni	possible								
Little Mastiff Bat	Mormopterus sp.	possible								
n/a	Vespadelus spp.	definite								
a large-eared bat	Nyctophilus spp.	definite								
White-Striped Mastiff Bat	Tadarida australis	definite								
Lace Monitor	Varanus varius									
South-eastern Morethia Skink	Morethia boulengeri									
Spiny-palmed snake-eyed skink	Cryptoblepharus carnabyi									

Common Name	Scientific Name	Comment	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 3 Bethungra Valve Station	Site 4 Billabung Creek	Site 5 Illabo Road	Site 6 Gravel Road	Site 7 Gundagai Rd	Site 8 Rocky Outcrop
Eastern striped skink	Ctenotus robustus									
Olive Snake-lizard	Delma inornata									
*= introduced species, **Bold** text = threatened species (including preliminary determinations)										

Table 13 Flora Species Recorded During Survey

Common Name	Scientific Name	Weed status	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 1 Road near Bethungra	Site 2 Illabo Rd	Site 3 Dirt Road	Site 4 Billabung Creek	Site 5 Gundagai Rd	Site 6 Rocky Outcrop
Box-leaf Wattle	Acacia buxifolia									
Silver Wattle	Acacia dealbata									
Green Wattle, Dean's Wattle	Acacia deanei									
Bent-leaf Wattle	Acacia flexifolia									
Early Wattle	Acacia genistifolia									
Hickory Wattle	Acacia implexa									
Varnish Wattle	Acacia verniciflua									
Mistletoe	Amyena spp.									
n/a	Aphanes australiana									
Capeweed	Arctotheca calendula	*								

Common Name	Scientific Name	Weed status	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 1 Road near Bethungra	Site 2 Illabo Rd	Site 3 Dirt Road	Site 4 Billabung Creek	Site 5 Gundagai Rd	Site 6 Rocky Outcrop
Wallaby Grass	Austrodanthonia spp.									
Tall Speargrass	Austrostipa bigeniculata									
Brushtail Speargrass	Austrostipa densiflora									
Corkscrew Speargrass	Austrostipa scabra									
Wild Oats	Avena fatua	*								
Red Grass, Red-leg Grass	Bothriochloa macra									
Kurrajong	Brachychiton populneus									
Quaking Grass	Briza maxima	*								
Great Brome	Bromus diandrus	*								
Soft Brome	Bromus molliformis	*								
White Cypress	Callitris glaucophylla									
Shepherd's Purse	Capsella bursa-pastoris	*								
Sticky Cassinia	Cassinia uncata									

Common Name	Scientific Name	Weed status	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 1 Road near Bethungra	Site 2 Illabo Rd	Site 3 Dirt Road	Site 4 Billabung Creek	Site 5 Gundagai Rd	Site 6 Rocky Outcrop
n/a	Chenopodium desertorum subsp. microphyllum									
Windmill Grass	Chloris truncata									
Common Everlasting, Yellow Buttons	Chrysocephalum apiculatum									
Australian Crassula	Crassula sieberiana									
Kidney Weed	Dichondra repens									
	Dianella revoluta									
Nodding Chocolate Lily	Dichopogon fimbriatus									
Wedge-leaf Hop-bush	Dodonaea viscosa subsp. cuneata									
Paterson's Curse	Echium plantagineum	#								
Climbing Saltbush	Einadia nutans subsp. linifolia									
Common Wheatgrass	Elymus scaber									
Blue Heron's Bill	Erodium crinitum									
White Box	Eucalyptus albens									
Blakely's Red Gum	Eucalyptus blakelyi									

Common Name	Scientific Name	Weed status	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 1 Road near Bethungra	Site 2 Illabo Rd	Site 3 Dirt Road	Site 4 Billabung Creek	Site 5 Gundagai Rd	Site 6 Rocky Outcrop
River Gum, River Red Gum	Eucalyptus camaldulensis									
Red Stringybark	Eucalyptus macrorrhyncha									
Grey Box	Eucalyptus microcarpa									
Mugga Ironbark	Eucalyptus sideroxylon									
Common Eutaxia	Eutaxia microphylla									
n/a	Goodenia pinnatifida									
Yorkshire Fog	Holcus lanatus	*								
Barley Grass	Hordeum sp.	*								
Catsear, Flatweed	Hypochaeris radicata	*								
Pinrush	Juncus filicaulis									
n/a	Lepidium africanum	*								
Peach Heath	Lissanthe strigosa									
ryegrasses	Lolium spp.	*								
Wattle Mat-rush	Lomandra filiformis									
Many-flowered Mat-rush	Lomandra multiflora									
African Boxthorn	Lycium ferocissimum	#								

Common Name	Scientific Name	Weed status	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 1 Road near Bethungra	Site 2 Illabo Rd	Site 3 Dirt Road	Site 4 Billabung Creek	Site 5 Gundagai Rd	Site 6 Rocky Outcrop
Small-flowered Mallow	Malva parviflora	*								
White Horehound	Marrubium vulgare	#								
medics	Medicago spp.	*								
Grassland Wood Sorrel	Oxalis perennans									
Native Poppy	Papaver aculeatum	*								
Phalaris	Phalaris aquatica	*								
Curver Rice-flower	Pimelea curviflora var. sericea									
Rice Millet	Piptatherum miliaceum	*								
Lamb's Tongues, Plantain	Plantago lancelota	*								
Variable Plantain	Plantago varia									
Jersey Cudweed	Pseudognaphalium luteoalbum									
Turnip Weed, Giant Mustard	Rapistrum rugosum	*								
Onion Grass	Romulea rosea	*								
Black Berry	*Rubus fruticosus*	#								
Swamp Dock	Rumex brownii									
Vervain	Salvia verbenaca	*								
Corrugated Sida	Sida corrugata									

Common Name	Scientific Name	Weed status	Site 1 Bethungra Mountain	Site 2 Old Sydney Road to Ulandra Creek	Site 1 Road near Bethungra	Site 2 Illabo Rd	Site 3 Dirt Road	Site 4 Billabung Creek	Site 5 Gundagai Rd	Site 6 Rocky Outcrop
Common Sowthistle	Sonchus oleraceus	*								
Nodding Blue Lily	Stipandra glauca									
Leafy Templetonia	Templetonia stenophylla									
Subterranean Clover	Trifolium subterraneum	*								
Stinging Nettle	Urtica incisa	*								
Fuzzy New Holland Daisy	Vittadinia cuneata									
Rat's Tail Fescue	Vulpia myuros	*								
Tufted Bluebell	Wahlenbergia communis									
*= introduced species, # = noxious weed, **Bold** text = threatened species (including preliminary determinations)										

Appendix C Potential for Threatened Species and Ecological Communities to Occur in the Study Area

Threatened flora species

Table 14 Threatened flora species recorded or considered likely to occur in vicinity and likelihood of occurrence in the study area.

Species Name	Status	Habitat Requirements / Comment (DECCW 2009)	Likelihood of Occurrence
Ammobium craspedioides Yass Daisy	Vulnerable (EPBC) Vulnerable (TSC)	Found from near Crookwell on the Southern Tablelands to near Wagga Wagga on the South Western Slopes. Most populations are in the Yass region. Found in dry forest, Box-Gum Woodland and secondary grassland derived from clearing of these communities. Grows in association with a large range of eucalypts (*Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. goniocalyx*, *E. macrorhyncha*, *E. mannifera*, *E. melliodora*, *E. polyanthemos*, *E. rubida*). Apparently unaffected by light grazing, as populations persist in some grazed sites.	Low to Moderate Near edge of species known distribution and not recorded during site investions.
Pilularia novae-hollandiae Austral Pillwort	Endangered (TSC)	The population at Lake Cowal is the only known extant population in NSW. Austral Pillwort grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous. Most of the records in the Albury-Urana area were from table drains on the sides of roads. This species is probably ephemeral (especially in the drier parts of its range), appearing when soils are moistened by rain.	Low Ephemeral waterways of the site do not appear to hold water for extended periods. Species not detected during fireld surveys.
Cullen parvum Small Scurf-pea	Endangered (TSC)	The Small Scurf-pea is known in NSW from only two herbarium collections; one from Wagga Wagga in 1884 and the other from Jindera (near Albury) in 1967. In Victoria, where populations still occur, plants are found in grassland, River Red Gum (Eucalyptus camaldulensis) Woodland and even grazing country and table drains, in areas with rainfall of between 450 and 700 mm. Plants tend to die back over summer and resprout with rain in winter or spring; in dry years, plants apparently do not always produce shoots but survive below the ground.	Low Very few records in region and species not detected during fireld surveys.
Euphrasia collina subsp. Muelleri Mueller's Eyebright	Endangered (TSC) Endangered (EPBC)	Once widespread in south-eastern Australia, Mueller's Eyebright is now known only from the Mornington Peninsula near Melbourne. It has been recorded in NSW in the upper Murray and McIntyre Rivers and was last recorded in NSW near Dorrigo in 1904 and near Cootamundra in 1887. Little is known about the habitat this species preferred, although there is a reference to "damp places" in an early von Mueller collection. Extant populations in Victoria occur in healthy woodland. Flowering has generally been recorded in spring and early summer, although one flowering collection from Dorrigo in 1904 was made in July.	Low Habitat within study area does not resemble the species' known habitat and and species not detected during fireld surveys.
Senecio garlandii Woolly Ragwort	Vulnerable (TSC)	This daisy is found between Temora, Bethungra and Albury and possibly Burrinjuck near Yass.	Low No suitable

Species Name	Status	Habitat Requirements / Comment (DECCW 2009)	Likelihood of Occurrence
	Vulnerable (EPBC)	Woolly Ragwort occurs on sheltered slopes of rocky outcrops. Flowering occurs in spring.	habitat for this species within study area and species not detected during fireld surveys.
Swainsona sericea Silky Swainson-pea	Vulnerable (TSC)	Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes.	Low to Moderate Potential habitat present however species not detected during fireld surveys.
Caladenia concolor Crimson Spider Orchid	Endangered (TSC) Endangered (EPBC)	The current known range of the Crimson Spider Orchid in NSW is confined to granite ridge country in the Nail Can Hill Crown Reserve near Albury. Habitat is regrowth woodland on granite ridge country that has retained a high diversity of plant species, including other orchids. The dominant trees are Blakely's Red Gum (Eucalyptus blakelyi), Red Stringybark (E. macrorhyncha), Red Box (E. polyanthemos) and White Box (E. albens); the diverse understorey includes Silver Wattle (Acacia dealbata), Hop Bitter-pea (Daviesia latifolia), Common Beard-heath (Leucopogon virgatus), Spreading Flax-lily (Dianella revoluta) and Poa Tussock (Poa sieberiana). This species is deciduous, producing a leaf during autumn or winter and after flowering in spring survives the dry summer and early autumn as a dormant tuber.	Low – no suitable habitat for this species within study area and species not detected during fireld surveys.
Diuris tricolor (Syn Diuris sheaffiana) Pine Donkey Orchid Tricolour Diuris	Vulnerable (TSC) Vulnerable (EPBC)	Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the far north of NSW. The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (*Callitris spp.*). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta*, Ironbark and *Acacia* shrubland. The understorey is often grassy with herbaceous plants such as *Bulbine* species. Flowers from September to November or generally spring. The species is a tuberous, deciduous terrestrial orchid and the flowers have a pleasant, light sweet scent.	Low – no suitable habitat for this species within study area and species not detected during fireld surveys.
Prasophyllum petilum Tarengo Leek Orchid	Endangered (TSC) Endangered (EPBC)	Known from two sites in the NSW Southern Tablelands; at Boorowa and Captains Flat. Also at Hall in the Australian Capital Territory. Grows in open sites within Natural Temperate Grassland at the Boorowa site. Also grows in grassy woodland in association with River Tussock *Poa labillardieri* Black Gum *Eucalyptus aggregata* and tea-trees *Leptospermum* spp. at Captains Flat and within the grassy groundlayer of Box-Gum Woodland at Hall.	Low - species has not been recorded in the Upper Slopes subregion. The species is predicted to occur only east of Binalong in this subregion.

Species Name	Status	Habitat Requirements / Comment (DECCW 2009)	Likelihood of Occurrence
		Apparently highly susceptible to grazing, being retained only at a little-grazed travelling stock reserve (Boorowa) and in cemeteries (Captains Flat and Hall). Flowers in October at Boorowa and December at Captains Flat.	
Grevillea wilkinsonii Tumut Grevillea	Endangered (TSC) Endangered (EPBC)	The Tumut Grevillea is found in two areas: one is a 4.5 km stretch of the Goobarragandra River, approximately 18 km south-east of Tumut; the other at a small site near Gundagai. The associated native vegetation includes remnant riverine shrub communities adjacent to open-forest, with the most common tree species being Blakely's Red Gum (Eucalyptus blakelyi), Apple Box (E. bridgesiana), Yellow Box (E. melliodora), and Red Stringybark (E. macrorhyncha) and with Kurrajongs (Brachychiton populneus) growing in nearby paddocks.	Low – The distribution of the species is restricted to within 25 km of Tumut. No suitable habitat for this species within study area and species not detected during fireld surveys.
Pomaderris cotoneaster Cotoneaster Pomaderris	Endangered (TSC) Endangered (EPBC)	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern Kosciuszko National Park (near Tumut), the Tantawangalo area in South-East Forests National Park and adjoining freehold land, Badgery's Lookout near Tallong, the Yerranderie area, the Canyonleigh area and Ettrema Gorge in Morton National Park. Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.	Low - species has not been recorded in the Upper Slopes subregion. The species is predicted to occur only east of Tumut in this subregion. No suitable habitat for this species within study area and species not detected during fireld surveys.
Pultenaea humilis Dwarf Bush Pea	Vulnerable (TSC)	*Pultenaea humilis* is rare in New South Wales and Tasmania, but relatively common in Victoria. In NSW, Pultenaea humilis is currently known from three confirmed localities in the NSW South Western Slopes bioregion Occurs on a variety of soils ranging from sandy loams to clays. Pultenaea humilis is found in isolated remnants of native woodland and forest communities that occur in extensively cleared agricultural landscapes.	Low to Moderate Species only recorded south of the Wagga Wagga district and not recorded during field surveys.
Tylophora linearis	Vulnerable (TSC) Endangered (EPBC)	Found in the Barraba, Mendooran, Temora and West Wyalong districts in the northern and central western slopes of NSW. Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina luehmannii.	Low Species not recorded in the South West Slopes Bioregion and not suitable habitat present.

Threatened ecological communities

Table 15 Threatened ecological communities recorded or considered likely to occur in vicinity and likelihood of occurrence in the study area.

Community Name	Status	Habitat Requirements / Comment (DECCW 2009)	Likelihood of Occurrence
Inland Grey Box Woodland in the Riverina; NSW South Western Slopes; Cobar Peneplain; Nandewar and Brigalow Belt South Bioregions	Endangered (TSC Act)	In NSW the community principally occurs within the Riverina and South West Slopes Bioregions and is also found in portions of the Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions. Inland Grey Box Woodland occurs on fertile soils of the western slopes and plains of NSW. The community generally occurs where average rainfall is 375- 800 mm pa and the mean maximum annual temperature is 22- 26°C. There is a correlation between the distribution of *Eucalyptus microcarpa* communities and soils of Tertiary and Quaternary alluvial origin, largely corresponding with the Red Brown Earths. The majority of remnant patches of Inland Grey Box Woodland survive with trees largely intact but with the shrub or ground layers degraded to varying degrees through grazing or pasture modification. Some species that are part of the community appear intolerant to heavy grazing by domestic stock and are confined to the least disturbed remnants.	Low This community chiefly occurs further to the west of the study area. A similar community recorded in the vicinity of the Bethungra Line Valve however this vegetation appears to be a variant (ID 267, Benson 2008) of Box Gum Woodland.
Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)	Not listed (TSC Act) Endangered (EPBC Act)	Occurs in the Southern Tablelands of NSW (an area bounded by the Snowy Mountains and Brindabella Range in the south-west, coastal ranges and escarpments to the east, extending north to the Abercrombie River, with a north-western boundary extending from Burrinjuck Dam to Boorowa, then east to the Lachlan River and north to Wyangala Dam). Contained within the South Eastern Highlands bioregion and within an altitude range of between 560 and 1200 metres. Occurs in a variety of landforms but generally occur on the fertile lower parts of the landscape (flats, drainage lines, frost hollow valleys, foothills) where resources such as water and nutrients are abundant, but tree growth is restricted by periodic drying or waterlogging, frosting, or exposure to westerly winds; remnants also occur on midslopes to hilltops and plateaux, particularly in basalt country, but also where exposure and soil conditions limit tree growth on	Low Habitat for the community restricted to Southern Tablelands section of the Upper slopes subregion. Vegetation community not recorded during site survey.

Community Name	Status	Habitat Requirements / Comment (DECCW 2009)	Likelihood of Occurrence
		other substrates.	
White Box Yellow Box Blakely's Red Gum Woodland	Endangered (TSC Act) Critically Endangered (EPBC Act)	It occurs in the tablelands and western slopes of NSW. Characterized by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. Remnants generally occur on fertile lower parts of the landscape where resources such as water and nutrients are abundant.	This community was identified as occuring at several locations within the study area (see Table B3 for details)

Assessment of the presence of threatened ecological communities in the study area

Table 16 Assessment of the presence of State (TSC Act) listed Box Gum Woodland in the study area

Criteria for inclusion (NSW National Parks and Wildlife Service)	1 Bethungra Mountain	2 Ulandra Creek	3 Road near Bethungra	4 Billabung Creek	5 Illabo Rd	6 Dirt Road	7 Gundagai Rd	8 Rocky Outcrop
Is the site is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are there are any native species in the understorey?	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Are White Box, Yellow Box or Blakely's Red Gum, or a combination of these species present or were they previously present?	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Is the site is likely to respond to assisted natural regeneration?	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Is the subject site predominantly grassy?	No	Yes	Yes	n/a	Yes	Yes	Yes	Yes
Is the understorey of the site dominated by shrubs excluding pioneer species?	Yes	No	No	n/a	No	No	Yes	No
Conclusion	Not the listed ecological community.	The listed ecological community	The listed ecological community.	Not the listed ecological community.	The listed ecological community.	The listed ecological community.	The listed ecological community.	Not the listed ecological community.

Table 17 Assessment of the presence of Commonwealth (EPBC Act) listed White Box, Yellow Box, Blakely's Red Gum Grassy Woodland in the study area

Criteria for inclusion (EPBC Policy Statement 3.5)	1 Bethungra Mountain	2 Ulandra Creek	3 Road near Bethungra	4 Billabung Creek	5 Illabo Rd	6 Dirt Road	7 Gundagai Rd	8 Rocky Outcrop
Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum?	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Does the patch have a predominantly native understorey	Yes	Yes	No	No	Yes	Yes	Yes	No
Is the patch greater than 0.1 ha in size with 12 or more native understorey species including at least one important species	No	No	n/a	n/a	Yes	No	Yes	n/a
Is the patch greater than 2 ha in size with an average of 20 or more mature trees per hectare or is there natural regeneration of the dominant overstorey eucalypts?	Yes	Yes	n/a	n/a	Yes	Yes	Yes	n/a
Conclusion	Not the listed ecological community.	The listed ecological community.	Not the listed ecological community.	Not the listed ecological community.	The listed ecological community.	The listed ecological community.	The listed ecological community.	Not the listed ecological community.

Threatened fauna

Table 18 Threatened fauna species recorded or considered likely to occur in vicinity and likelihood of occurrence in the study area

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Greater Long-eared Bat	Nyctophilus timoriensis (South-eastern form)	Bat	Vulnerable	Vulnerable	Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	Roosts in tree hollows, crevices, and under loose bark.	Low to Moderate Vegetation of the study area has potential as habitat but species not recorded in Upper slopes subregion.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Large-footed Myotis	Myotis macropus (formally Myotis adversus)	Bat	Vulnerable	n/a	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Foraging habitat includes waterbodies (including streams, lakes or reservoirs) and vegetation within 20m of waterbody. Roosting and breeding habitat includes live or dead hollow-bearing trees, under bridges or other artificial structures, in caves, or in dense foliage.	Low No foraging or likely roosting habitat recorded in the study area.
Little Pied Bat	Chalinolobus picatus	Bat	Vulnerable	n/a	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.	Roosting and breeding habitat includes tree hollows, fissures or cracks, buildings, powerpoles, fenceposts, caves, cliff crevices, mine shafts, tunnels.	High Recorded in study area.
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	Bat	Vulnerable	n/a	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Breeds in live or dead hollow-bearing trees. Roosts in live or dead hollow-bearing trees , under exfoliating bark, in burrows of terrestrial mammals in treeless areas, bird nests or sugar glider nests.	Moderate to High

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	Bats	Vulnerable	n/a	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Hunt in forested areas, catching moths and other flying insects above the tree tops	Breeding habitat includes caves including known maternity colony at Wee Jasper.	High Recorded within study area Maternity colonies unlikely
Australian Painted Snipe Painted Snipe	Rostratula australis (syn. Rostratula benghalensis)	Bird	Endangered	Vulnerable	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Areas of tussock grass, or reeds, or sedges, or rushes, or lignum within 500 m and including permanent and ephemeral shallow (<50 cm) wetlands and water bodies or inundated grassland and paddocks	Low Not recorded in Upper slopes subregion and not suitable habitat present.
Barking Owl	Ninox connivens	Bird	Vulnerable	n/a	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting.	Breeding habitat includes living or dead trees with hollows >20 cm diameter that are > 4 m above the ground. Foraging habitat includes timbered areas and up to 250 m from these in grasslands	Moderate to High Likely breeding pair observed at Site 2 near Ulandra Creek. May also breed, forage and shelter in the vicinity of Billabung Creek and may also forage in nearby road reserves.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	Bird	Vulnerable	n/a	The subspecies 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, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially *Eucalyptus sideroxylon*, *Eucalyptus albens*, *Eucalyptus microcarpa*, *Eucalyptus melliodora* and *Eucalyptus tereticornis*. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	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 hectares The species does not persist in remnants less than 200 ha in area.	Low Vegetation patches of the study area are small, linear and fragmented.
Blue-billed Duck	Oxyura australis	Bird	Vulnerable	n/a	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation.	Freshwater and brackish wetlands with emergent aquatic vegetation (including Typha, Phragmites and Lignum) and open water > 1 m deep	Low Minimal

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Brolga	Grus rubicunda	Bird	Vulnerable	n/a	The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It still abundant in the northern tropics, but very sparse across the southern part of its range.	Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged.	Low
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	Bird	Vulnerable	n/a	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 western boundary of its range runs through Wagga Wagga, Temora, Forbes, Dubbo and Inverell. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species	Usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Hollows in standing dead or live trees and tree stumps are essential for nesting.	High Recorded on site in areas of River Red Gum forest at Site 2 & Site 4.
Bush Stone-curlew	Burhinus grallarius	Bird	Endangered	n/a	Inhabits open forests and woodlands with a sparse grassy groundlayer, leaf litter and fallen timber.	n/a	Low to Moderate

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Diamond Firetail	Stagonopleura guttata	Bird	Vulnerable	n/a	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Moderate Vegetation patches of the study area are small, linear and fragmented.
Flame Robin	Petroica phoenicea	Bird	Vulnerable (preliminary determination)	n/a	In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains.	Clearing and degradation of breeding habitat, and degradation of wintering habitat are key threats to the species. For instance, habitat in the sheep-wheat belt is subject to degradation by overgrazing and simplification by the removal of standing dead timber, logs and coarse woody debris.	Moderate

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Freckled Duck	Stictonetta naevosa	Bird	Vulnerable	n/a	The Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat.	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	Low
Gang-gang Cockatoo	Callocephalon fimbriatum	Bird	Vulnerable	n/a	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	Breeding habitat includes hollows >10 cm diameter >9m above the ground in eucalypts	Moderate May forage in area during winter but unlikely to occur at other times or breed in area.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Gilbert's Whistler	Pachycephala inornata	Bird	Vulnerable	n/a	The Gilbert's Whistler occurs in ranges, plains and foothills in arid and semi-arid timbered habitats. In NSW it occurs mostly in mallee shrubland, but also in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests.	Patches of dense understorey shrubs associated with mallee or woodland are essential for territorial pairs to breed.	Low Vegetation type considered marginal as habitat for species and patches are small, linear and fragmented with low shrub density.
Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	Bird	Vulnerable	n/a	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas.	Moderate Vegetation patches of the study area are small, linear and fragmented.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	Bird	Vulnerable	n/a	The Hooded Robin is common in few places, and rarely found on the coast. The south-eastern form is found from Brisbane to Adelaide throughout much of inland NSW, with the exception of the north-west. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches.	In temperate woodlands, the species favours open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover (Fitri and Ford 1997). The species appears unable to survive in remnants smaller than 100-200ha (Egan et al. 1997; N. Schrader, unpubl.).	Low Vegetation patches of the study area are small, linear and fragmented.
Little Eagle	Hieraaetus morphnoides	Bird	Vulnerable (preliminary determination)	n/a	The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993; Aumann 2001a). For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	The main threats to the Little Eagle are inferred to be clearing and degradation of its foraging and breeding habitat. Over 50% of forest and woodland has been cleared in NSW.	High

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Little Lorikeet	Glossopsitta pusilla	Bird	Vulnerable (preliminary determination)	n/a	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes.	On the western slopes and tablelands White Box Eucalyptus albens and Yellow Box E. meliodora are particularly important food sources for pollen and nectar respectively (Courtney & Debus 2006). They are also reported as feeding on fruits, particularly those of mistletoes (Higgins 1999).	Moderate to High
Painted Honeyeater	Grantiella picta	Bird	Vulnerable	n/a	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	Vegetation with 5 or more mistletoes per hectare	Low to Moderate Mistletoe density low in trees of the study area.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Regent Honeyeater	Xanthomyza phrygia	Bird	Endangered	Endangered	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	The species can undertake large-scale nomadic movements in the order of hundreds of kilometres. Can utilize fragmented environments for occasional foraging. Important habitat includes areas where there is >10% native vegetation cover within a 20 km radius of the site.	High to Moderate Vegetation patches of the study area are small, linear and fragmented and vegetation cover is low. Likely only to be occasional foraging habitat.
Scarlet Robin	Petroica multicolor	Bird	Vulnerable (preliminary determination)	n/a	The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees.	Its occurrence (presence/absence) is positively associated with patch size and components of habitat complexity including increasing tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter.	Moderate

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Speckled Warbler	Pyrrholaemus saggitatus	Bird	Vulnerable	n/a	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies	The species has low population densities and relatively large home range requirements It appears to be extinct in districts where no fragments larger than 100ha remain.	Low to Moderate Vegetation patches of the study area are small, linear and fragmented and vegetation cover is low.
Spotted Harrier	Circus assimilis	Bird	Vulnerable (preliminary determination)	n/a	The Spotted Harrier occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	The main threats to the Spotted Harrier are clearing and degradation of foraging and breeding habitat, particularly that which affects prey densities. Important bioregions on the NSW western slopes and plains which contained high harrier breeding densities until the 1980s are now 40-84% cleared, 85-91% grazed and moderately to highly stressed.	Moderate
Square-tailed Kite	Lophoictinia isura	Bird	Vulnerable	n/a	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	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. Appears to occupy large hunting ranges of more than 100km2.	Low to Moderate Vegetation patches of the study area are small, linear and fragmented and may not be sufficient to support a population of this species.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Superb Parrot	Polytelis swainsonii	Bird	Vulnerable	Vulnerable	Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box.	On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Nest in small colonies, often with more than one nest in a single tree. May forage up to 10 km from nesting sites, primarily in grassy box woodland.	High Recorded at Site 4 (Billabung Creek) and Site 5 where feeding and breeding may occur.
Swift Parrot	Lathamus discolor	Bird	Endangered	Endangered	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Commonly used lerp infested trees include Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis.	The Swift Parrot is dependent on flowering resources across a wide range of habitat in its wintering grounds in New South Wales (Shields and Crome 1992).	Moderate to High Vegetation patches of the study area are small, linear and fragmented and vegetation cover is low. Likely only to be occasional foraging habitat.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Turquoise Parrot	Neophema pulchella	Bird	Vulnerable	n/a	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland	Usually nest less than two metres above the ground. Nests may be located in hollows of small trees, dead eucalyptus or in holes or stumps, fence posts or even logs lying on the ground (Quinn & Baker- Gabb 1993).	Moderate Vegetation patches of the study area are small, linear and fragmented however this species may persist.
Varied Sitella	Daphoenositta chrysoptera	Bird	Vulnerable (preliminary determination)	n/a	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	The sedentary nature of the Varied Sittella makes cleared agricultural land a potential barrier to movement. Survival and population viability are sensitive to habitat isolation, reduced patch size and habitat simplification, including reductions in tree species diversity, tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter. The sittella is also adversely affected by the dominance of Noisy Miners in woodland patches.	Moderate
White-browed Woodswallow	Artamus superciliosus	Bird	Vulnerable (preliminary determination)	n/a	The White-browed Woodswallow inhabits mostly eucalypt, sheoak and Acacia woodland, including mallee, and adjacent open areas including grassland with scattered trees or shrubs. In agricultural landscapes it prefers healthy woodland patches with low disturbance and little grazing	The apparent population decline may be due to limitations of food supply and foraging substrates which are depleted by clearing and degradation of the tree and shrub layer, firewood collection, and ‘tidying up’ on farms.	High Several birds recorded roosting in tree at Site 7

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
White-fronted Chat	Epthianura albifrons	Bird	Vulnerable (preliminary determination)	n/a	The White-fronted Chat is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands or lightly timbered lands	n/a	Low to Moderate
Macquarie Perch	Macquaria australasica	Fish	Endangered	Endangered	Macquarie perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers. Macquarie perch.	Found in both river and lake habitats, especially the upper reaches of rivers and their tributaries.	Low No riverine or lake habitat near study area.
Murray Cod, Cod, Goodoo	Maccullochella peelii peelii	Fish	n/a	Vulnerable	The Murray Cod is found in a wide range of warm water habitats, from clear, rocky streams to slow-flowing turbid rivers and billabongs.	Generally, they are found in waters up to 5 m deep and in sheltered areas with cover from rocks, timber or overhanging banks (SPRAT DEWHR 2009).	Low No riverine habitat within or the study area.
Silver perch	Bidyanus bidyanus	Fish	Vulnerable	n/a	Silver perch were once widespread and abundant throughout most of the Murray-Darling river system. Only one remaining secure and self sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, aswell as several anabranches and tributaries (NSW DPI Priorities Action Statement)	Silver perch seem to prefer fast-flowing, open waters, especially where there are rapids and races, however they will also inhabit warm, sluggish water with cover provided by large woody debris and reeds (NSW DPI Priorities Action Statement).	Low No potential habitat exists within the study area.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Booroolong Frog	Litoria booroolongensis	Frog	Endangered	Endangered	The Booroolong Frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. Most recent records are from the south-west slopes of NSW. Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge.	Permanent rocky streams with fringing groundcover or understorey vegetation – uses vegetation within 100m for foraging and sheltering. It typically occurs in western-flowing creeks and their headwaters, although a small number of animals have also been recorded in eastern-flowing streams.	Low Ephemeral streams with minimal understorey and no cobble banks or rock structures only present within study area.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Sloane's Froglet	Crinia sloanei	Frog	Vulnerable	n/a	Sloane's Froglet has been recorded from widely scattered sites in the floodplains of the Murray-Darling Basin, with the majority of records in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions in New South Wales. At a number of sites where records are verified by museum specimens, the species has not been subsequently detected during more recent frog surveys in the vicinity (e.g. Holbrook, Nyngan, Wagga Wagga and Tocumwal).	It is typically associated with periodically inundated areas in grassland, woodland and disturbed habitats.	Low to Moderate Marginal potential habitat present.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Southern Bell Frog	Litoria raniformis	Frog	Endangered	Vulnerable	In NSW the species was once distributed along the Murray and Murrumbidgee Rivers and their tributaries, the southern slopes of the Monaro district and the central southern tablelands as far north as Tarana, near Bathurst. Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.	During the breeding season animals are found floating amongst aquatic vegetation (especially cumbungi or Common Reeds) within or at the edge of slow-moving streams, marshes, lagoons, lakes, farm dams and rice crops.	Low No appropriate habitat present in the study area.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Golden Sun Moth	Synemon plana	Invertebrate	Endangered	Critically Endangered	Restricted within the Upper Slopes to a radius of 15 k west of Binalong and eastwards to the subregion's eastern-most boundary; and in a radius of 15 km from Tumut. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses *Austrodanthonia* spp.	The bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses *Austrostipa* spp. or Kangaroo Grass *Themeda australis*.	Low No Natural Temperate Grasslands present within or in close proximity to the study area and the ground layer not dominated by *Austrodanthonia* spp.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Brush-tailed Phascogale	Phascogale tapoatafa	Marsupial	Vulnerable	n/a	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is more frequently found in forest on the Great Dividing Range in the north-east and south-east of the State. There are also a few records from central NSW. Not recorded in SWS region however habitat is predicted to occur. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Agile climber foraging preferentially in rough barked trees of 25 cm DBH or greater..	Breeding habitat includes tree hollows, logs or stumps with entrances > 2.5 cm wide for nesting and sheltering; most abundant where there are > 2 trees per ha > 60cm DBH; nest trees are typically large (>80 cm DBH) but can be as small as 25cm DBH Foraging habitat includes open forest or woodland; prefer large trees (>60 cm DBH); uses patches <1 ha if within 150 m of other patches in floodplain box & riverine woodlands; landscape sizes >25ha in dry forests and ridges	Low Woodland vegetation type considered marginal, not recorded in region and vegetation of study area of small patch size.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Eastern Pygmy-possum	Cercartetus nanus	Marsupial	Vulnerable	n/a	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (Pseudocheirus peregrinus) dreys or thickets of vegetation, (eg. grass-tree skirts); tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	Foraging habitat includes areas with understorey containing Banksias or other proteaceous or myrtaceous shrubs incl. Melaleucas, Tea-trees & Callistemons; can use woodlands without understorey.	Low No proteaceous or myrtaceous shrubs in understorey. Vegetation is fragmented and edge affected.
Koala	Phascolarctos cinereus	Marsupial	Vulnerable	n/a	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Individual Koalas within a population have large overlapping home ranges	n/a	Low It is unlikely that sufficient vegetation extent and connectivity exists in the study area to support a population of this species.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Spotted-tailed Quoll	Dasyurus maculatus	Marsupial	Vulnerable	Endangered	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. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares; usually traverse their ranges along densely vegetated creeklines.	Sheltering and breeding habitat includes hollow-bearing trees, fallen logs, small caves, rock crevices, boulder piles, rocky-cliff faces or animal burrow.	Low It is unlikely that sufficient vegetation extent and connectivity exists in the region to support a population of this species.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Squirrel Glider	Petaurus norfolcensis	Marsupial	Vulnerable	n/a	Inhabits a wide range of open forest, woodland and riverine forest habitats. Utilise remnants of various sizes, including small remnants and even small stands of trees within Travelling Stock Reserves, roadside reserves or private land. Often utilise linear remnant vegetation along roadsides or rivers and streams. Eucalypt species known to provide suitable denning and foraging resources include (but are not restricted to): Blakely's Red Gum (E. blakelyi), Grey Box (E. microcarpa), Red Box (E. polyanthemos), Mugga Ironbark (E. sideroxylon), River Red Gum (E. camaldulensis), White Box (E. albens) and Yellow Box (E. melliodora). Some Acacia species are also a key foraging habitat at certain times of the year	Live in family groups and require abundant tree hollows for refuge and nest sites, so are more likely to inhabit mature or old growth forest. Breeding and sheltering habitat includes trees with hollows > 5 cm diameter in eucalypt forests and woodlands. Foraging habitat includes mature or mixed-age eucalypt dominated vegetation., especially areas containing flowering shrubs and wattles in the understorey; will occur where no understorey if there is > one species of eucalypt; dry forests ironbarks, box & bloodwoods; can use patch <1 ha & isolated trees if within 75 m of other patches	Moderate Few records of species in the vicinity of study area. Potential habitat exists in road reserves and adjacent paddock trees.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Squirrel Glider population in the Wagga Wagga LGA	Petaurus norfolcensis - endangered population Wagga Wagga	Marsupial	Endangered Population	n/a	The extent of the endangered population is legally defined by the boundaries of the Wagga Wagga LGA. The distribution of the Squirrel Glider and its known or potential habitats within, or linked across, this boundary is not well defined. However, potential habitat occurs at low densities and is patchily distributed on public lands (TSRs, NPWS reserves, Bush Heritage Trust reserves) private lands and roadside corridors with remnant vegetation. Inhabits a wide range of open forest, woodland and riverine forest habitats. Utilise remnants of various sizes, including small remnants and even small stands of trees within Travelling Stock Reserves, roadside reserves or private land. Often utilise linear remnant vegetation along roadsides or rivers and streams. Eucalypt species known to provide suitable denning and foraging resources include (but are not restricted to): Blakely's Red Gum (E. blakelyi), Grey Box (E. microcarpa), Red Box (E. polyanthemos), Mugga Ironbark (E. sideroxylon), River Red Gum (E. camaldulensis), White Box (E. albens) and Yellow Box (E. melliodora). Some Acacia species are also a key foraging habitat at certain times of the year	Live in family groups and require abundant tree hollows for refuge and nest sites, so are more likely to inhabit mature or old growth forest. Between April 1996 and October 1998, five sightings of Squirrel Gliders were made in Wiradjuri Reserve and Wilks Park, two adjacent reserves that adjoin the Murrumbidgee River in North Wagga Wagga. Three Squirrel Glider records from 1993, 1994 and 1995 are known from 25-30km south of Wagga Wagga. The nearest Squirrel Glider sightings after these are four from near Cootamundra to the north-east (pre-1900, 1954, 1995 and 1999) and two from Albury in the south (1954).	Low No suitable woodland vegetation present within the section of the study area that is within Wagga Wagga LGA.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Yellow-bellied Glider	Petaurus australis	Marsupial	Vulnerable	n/a	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	Tall, typically mature, eucalypt forest, generally in areas with high rainfall and nutrient rich soils. Moist gullies or creek flats to montane forests. Large trees with hollows greater then 10cm diameter required for shelter and breeding.	Low Grassy woodlands are not considered to be habitat for this species.
Pink-tailed Worm-lizard	Aprasia parapulchella	Reptile	Vulnerable	Vulnerable	The Pink-tailed Worm Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*).	Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites.	Low to Moderate Species not recorded within Upper Slopes subregion of the South West Slopes however it is predicted to occur.

Common Name	Scientific Name	Type of species	TSC Act or FM Act Status	EPBC Act Status	Distribution and Broad Habitat Requirements (DECCW 2009)	Specific Habitat Requirements (DECCW 2009)	Likelihood
Rosenberg's Goanna	Varanus rosenbergi	Reptile	Vulnerable	n/a	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Found in heath, open forest and woodland.	Individuals require large areas of habitat. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component.	Low Species is predicted to be restricted to the eastern third of Upper Slopes subregion, south-east of a line that runs through Tarcutta and Galong.
Striped Legless Lizard	Delma impar	Reptile	Vulnerable	Vulnerable	The Striped Legless Lizard occurs in the Southern Tablelands, the South Western Slopes and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland.	Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda australis*, spear-grasses *Austrostipa* spp. and poa tussocks *Poa* spp., and occasionally wallaby grasses *Austrodanthonia* spp. Sometimes present in modified grasslands with a significant content of exotic grasses. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter.	Moderate Marginal habitat in the form of disturbed open Box-Gum Woodland present in the study area.

Figure 1 Extremely large, hollow bearing tree located within the proposed pipeline footprint

Figure 2 Remnant Box Gum woodland located alongside the existing pipeline easement

Figure 3 Hollow bearing trees, in which the Superb Parrot was observed, located within the proposed pipeline footprint

Appendix A Assessments of Impact on State (TSC Act) Listed Threatened Species

The threatened flora and fauna species have been categorised into groups with broadly similar habitat requirements for the purpose of this assessment.

Table 19 Squirrel Glider Petaurus norfolcensis

Squirrel Glider Petaurus norfolcensis	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Lifecycle a) impact on lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	The proposed works may affect potential breeding habitat for this species as several hollow-bearing trees would be removed. As the species typically uses multiple den sites, the hollows that would be removed appear to be regularly utilised by nesting parrots and surveys failed to detect the species in this location the hollows to be removed are not considered likely to be utilised by this species. The removal of these few hollows is not considered likely to place a viable local population of the species at risk of extinction.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	Approximately 0.6 hectares of potential foraging habitat for this species in the form of eucalypts and shrubby understorey would be removed. Replanting of trees and shrubs in adjacent areas would however replace much of the lost potential foraging habitat.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to glide in excess of 50 metres, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species in the locality	Squirrel gliders have not been recorded in the vicinity of the study area however potential habitat for this species exits here and it is possible that the species may persist. The habitat of the road reserves is the only potential habitat for this species remaining within the study area and may be of importance to the recovery of any local populations of this species.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No recovery plan has been prepared for this species however five recovery strategies including nine recovery actions have been identified. Most of these actions relate specifically to research and management actions undertaken by government bodies. The following recovery action is however considered to be of relevance to the project: 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. In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, would be undertaken.
Key Threatening Processes g) whether the action 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	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees.

Squirrel Glider Petaurus norfolcensis	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
threatening process.	The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 20 Hollow-roosting microbat species

Hollow-roosting microbat species (Little Pied Bat Chalinolobus picatus and Yellow-bellied Sheathtail-bat Saccolaimus flaviventris)	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Lifecycle a) impact on lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	The proposed works may affect potential breeding habitat for these species as several hollow-bearing trees would be removed within the Box Gum woodland of the road reserves and some of the isolated paddock trees are also likely to contain hollows. Both of these species use a wide variety of roosting sites including man-made structures. The hollows and isolated paddock trees to be removed may be utilised by these species however given the range of root sites used by these species, the removal of these few hollows is not considered likely to place a viable local population of either species at risk of extinction.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	Approximately 0.6 hectares of potential foraging habitat for these species in the form of air spaces around and between eucalypts and shrubby understorey would be modified however this modification is not considered likely to substantially alter the value of these areas to these species. Approximately 50 isolated paddock trees within the farmland of the study area, some of which may contain potential roosting habitat for these species, may also be removed.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	Due to the small amount of habitat removed at each road and waterway crossing and the ability of these species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species in the locality	The habitat of the road reserves and Billabung Creek is considered likely to be important for the conservation and recovery of these species in the locality as these areas alone contain regenerating trees which can provide future roosting habitat for these species. This habitat extends well beyond the study area and not considered likely to be significantly impacted by the project.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No threat abatement plans of relevance to these species have been prepared. No recovery plan has been prepared for these species however recovery strategies and recovery actions have been identified. Most of these actions relate specifically to research and management actions undertaken by government bodies. The following recovery action is however considered to be of relevance to the project: 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. Identify riparian vegetation in a wide strip bordering creeks and rivers on Western Slopes and Plains as areas of high conservation value in planning instruments and EIA development assessments.

Hollow-roosting microbat species (Little Pied Bat Chalinolobus picatus and Yellow-bellied Sheathtail-bat Saccolaimus flaviventris)	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
	In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, would be undertaken.
Key Threatening Processes g) whether the action 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.	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees. The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 21 Cave-roosting microbat species

Cave-roosting microbat species - Eastern Bentwing-bat Miniopterus schreibersii oceanensis	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Lifecycle a) impact on lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	The proposed works would not affect potential breeding or hibernation habitat for this species as the species breeds and hibernates in caves. Caves are absent from the study area. During non-breeding activity the species uses a wider variety of roosting sites including man-made structures such as buildings mines and bridges but is not known to use tree hollows. The life cycle of this species is not likely to be significantly impacted by the proposal.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	Potential foraging habitat for this species in the form of air spaces around and between eucalypts and shrubby understorey would be modified however this modification is not considered likely to substantially alter the value of these areas to the species.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species in the locality	The habitat of the road reserves and Billabung Creek is considered likely to be of moderate importance for the conservation and recovery of the species in the locality as these areas provide the most suitable foraging habitat in the locality. The value of these areas is not considered likely to be significantly modified by the proposal.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan	No threat abatement plans of relevance to this species have been prepared. No recovery plan has been prepared for these species however recovery strategies and recovery actions have been identified.

Cave-roosting microbat species - Eastern Bentwing-bat Miniopterus schreibersii oceanensis	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
or threat abatement plan	Most of these actions relate specifically to research and management actions undertaken by government bodies. In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, would be undertaken.
Key Threatening Processes g) whether the action 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.	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees. The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 22 Superb Parrot Polytelis swainsonii

Superb Parrot Polytelis swainsonii	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Lifecycle a) impact on lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	The removal of hollow-bearing trees and mature to semi-mature trees (potential future hollow-bearing trees) within road reservations may impact potential breeding habitat for this species. The two adjacent hollow-bearing trees within the road reserve at Site 3 which would be removed showed signs of utilisation by parrots and appear to be of a size and in a location that may make them suitable as nesting site for the Superb Parrot. It is however unknown whether these hollows are utilised by the species. It is possible that some of the isolated paddock trees that would be removed may contain suitable nesting habitat for this species.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	Two known hollow-bearing trees, containing four hollows, would be removed from the woodland of the road reserve at Site 5. Some of the approximately 50 isolated paddock trees that would be removed may contain suitable nesting habitat for this species. Potential foraging habitat for this species in the form of native groundcover, shrub patches and woodland canopy would be modified however this modification is not considered likely to substantially alter the value of these areas to the species.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified,	The habitat that occurs within the road reserves and around the Ulandra and Billabung Creek areas is considered likely to be of high importance for the conservation and recovery of the species in the locality as these areas provide the most suitable foraging and potential breeding habitat. The value of these

Superb Parrot Polytelis swainsonii	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
fragmented or isolated to the long-term survival of the species in the locality	areas is however considered unlikely to be significantly modified by the proposal.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No threat abatement plans of relevance to this species have been prepared. No recovery plan has been prepared for this species however recovery strategies and recovery actions have been identified. Most of these actions relate specifically to research and management actions undertaken by government bodies. The following recovery action is however considered to be of relevance to the project: No loss of known or potential box-gum foraging habitat. In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, and native understorey vegetation would be undertaken. Replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves.
Key Threatening Processes g) whether the action 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.	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees. The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 23 **Swift Parrot**

Swift Parrot Lathamus discolor	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Lifecycle a) impact on lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	This species migrates to the Australian south-east mainland between March and October from its breeding distribution in Tasmania. It does not breed on the mainland. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. The woodland of the study area provides a potential food source for this species however, due to the relatively small extent and fragmentation of this habitat, the species is only considered likely to forage here on a sporadic basis.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	Approximately 4.0 hectares of Box Gum Woodland, including an area of approximately 3.0 hectares based around Site 2, as well as some of the approximately 50 isolated paddock trees that would be removed, may be used as foraging habitat by this species.
Fragmentation	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the

Swift Parrot Lathamus discolor	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species in the locality	The habitat of the road reserves and around Ulandra and Billabung Creeks is considered likely to be of moderate importance for the conservation and recovery of the species in the locality as these areas provide the most suitable foraging habitat yet are likely to be used on a sporadic basis. Overall, the value of these areas to the species is considered unlikely to be significantly modified by the proposal.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No threat abatement plans of relevance to this species have been prepared. No recovery plan has been prepared for this species however recovery strategies and recovery actions have been identified. Most of these actions relate specifically to research and management actions undertaken by government bodies. The following recovery action is however considered to be of relevance to the project: Enhance habitat for Swift Parrots by planting suitable tree species to complement natural regeneration or to enhance remnants In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, and native understorey vegetation would be undertaken. Replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves to compensate for tree losses.
Key Threatening Processes g) whether the action 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.	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees. The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 24 Regent Honeyeater

Regent Honeyeater Xanthomyza phrygia	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Lifecycle a) impact on lifecycle of the species such that a viable local	There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years

Regent Honeyeater Xanthomyza phrygia	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
population of the species is likely to be placed at risk of extinction,	non-breeding flocks converge on flowering coastal woodlands and forests. The woodland of the study area provides a potential food source for this species however, due to the relatively small extent and fragmentation of this habitat, and its distance from key breeding regions the species is only considered likely to forage here on a sporadic basis.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	The approximately 4.0 hectares of woodland and some of the approximately 50 isolated paddock trees that would be removed may be used as foraging habitat by this species.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species in the locality	The habitat of the road reserves and Ulandra and Billabung Creeks is considered likely to be of moderate importance for the conservation and recovery of the species in the locality as these areas provide the most suitable foraging habitat yet are likely to be used on a sporadic basis. The value of these areas to the species is considered unlikely to be significantly modified by the proposal.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No threat abatement plans of relevance to this species have been prepared. A Commonwealth recovery plan has been prepared for this species which contains six objectives. Most of these objectives relate specifically to research and management actions undertaken by government bodies. The following recovery objectives are however considered to be of relevance to the project: Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites. In accordance with this objective, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, and native understorey vegetation would be undertaken and replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves to compensate for tree losses.

Table 25 Small hollow-dependent woodland birds

Small hollow-dependent woodland birds - Brown Treecreeper (eastern subspecies) Climacteris picumnus victoriae Turquoise Parrot Neophema pulchella Little Lorikeet Glossopsitta pusilla	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Lifecycle a) impact on lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	The proposed works may affect potential breeding habitat for these species as several hollow-bearing trees would be removed. The hollows that would be removed appear to be regularly utilised by medium-sized to large nesting parrots and surveys failed to detect the above species in this location, the hollows to be removed are not considered likely to be utilised by these species. The removal of these few hollows is not considered likely to place a viable local population of the species at risk of extinction.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	Approximately 4.0 hectares of potential foraging habitat for these species in the form of eucalypt woodland, containing fallen timber and native understorey and groundcover vegetation would be removed. Replanting of trees in adjacent areas and relocation of fallen timber would however replace much of the lost potential foraging habitat.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species in the locality	The habitat of the road reserves and Ulandra and Billabung Creeks is the only potential habitat for these species remaining within the study area and is likely to be of high importance to the conservation and recovery of the local populations of this species. This habitat is not likely to be significantly modified by the works.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No recovery plan has been prepared for either of these species however five recovery strategies including nine recovery actions have been identified. Most of these actions relate specifically to research and management actions undertaken by government bodies. The following recovery action is however considered to be of relevance to the project: Implement sympathetic habitat management in conservation reserves, council reserves and crown reserves where the species occurs. In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, relocation of fallen timber and vegetation rehabilitation would be undertaken.
Key Threatening Processes g) whether the action 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.	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees.

Small hollow-dependent woodland birds - Brown Treecreeper (eastern subspecies) Climacteris picumnus victoriae Turquoise Parrot Neophema pulchella Little Lorikeet Glossopsitta pusilla	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
	The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 26 Wide-ranging Predatory Birds

Wide-ranging Predatory Birds Barking Owl *Ninox connivens* Square-tailed Kite *Lophoictinia isura*	
Relevant criteria from s92 of the TSC Act	Assessment of Impact
Lifecycle a) impact on lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,	No trees containing hollows of sufficient size for nesting by Barking Owls would be removed from the remnant woodland along the road reserves and waterways of the study area. No raptor nests were recorded along Ulandra or Billabung Creek or elsewhere in the study area. It is possible that some of the paddock trees to be removed many have potential as breeding habitat for these species, however these trees are considered marginal as potential nesting habitat due to their isolation from contiguous woodland habitat. The woodland of the study area provides potential foraging habitat for these species.
Habitat Removal d) (i) the extent to which the species habitat is likely to be removed or modified	The approximately 4.0 hectares of woodland and some of the approximately 50 isolated paddock trees that would be removed may be used as foraging habitat by these species. The proposed works are considered unlikely to significantly modify the foraging value of this habitat.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species in the locality	The habitat of the road reserves and the Ulandra and Billabung Creek areas is considered likely to be of high importance for the conservation and recovery of these species in the locality as these areas provide the most suitable foraging and potential nesting habitat. The value of these areas to the species is considered unlikely to be significantly modified by the proposal.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No threat abatement plans of relevance to these species have been prepared. A draft recovery plan has been prepared for the Barking Owl which contains five objectives and twenty recovery actions. Most of these objectives relate specifically to research and management actions undertaken by government bodies.

Wide-ranging Predatory Birds Barking Owl *Ninox connivens* Square-tailed Kite *Lophoictinia isura*	
Relevant criteria from s92 of the TSC Act	Assessment of Impact
	The following recovery actions are however considered to be of relevance to the project: Protect known Barking Owl nest sites and surrounding habitat Assist with the protection of Barking Owl habitat from disturbance due to developments and activities No recovery plan has been prepared for the Square-tailed Kite however recovery strategies and recovery actions have been identified. Most of these actions relate specifically to research and management actions undertaken by government bodies. The following recovery action is however considered to be of relevance to the project: Ensure implementation of management strategies that reduce disturbance of riparian areas In accordance with this objective, the minimum practicable clearing of vegetation, particularly mature trees in riparian areas would be undertaken and replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves to compensate for tree losses.
Key Threatening Processes g) whether the action 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.	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees. The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 27 Box-Gum Woodland

Box-Gum Woodland White Box Yellow Box Blakely's Red Gum Woodland	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
Effect on Extent c) (i) whether the action proposed is 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	Disturbance to approximately 4.0 hectares of this community over six locations, followed by restoration of native groundcover vegetation and supplementary tree and shrub planting is unlikely to result in a reduction in the extent of this community. The modification to vegetation structure caused over a very limited area at each site is unlikely to cause the community to be placed at increased risk of extinction.
Modification c (ii) whether the action proposed is 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	The proposed works will modify approximately 4.0 hectares of this community. This modification would take the form of tree removal and ongoing control of tree regrowth and soil disturbance. Whilst soil disturbance has the potential to encourage weed proliferation, the restoration of native groundcover vegetation is likely to improve the condition of this stratum. As tree cover is naturally patchy within this community, the project is considered unlikely to modify the composition of the ecological community such a degree that its local occurrence would be placed at increased risk of extinction.
Habitat Removal d) (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed	Disturbance to approximately 4.0 hectares of this community over six locations would be required, followed by restoration of native groundcover vegetation and supplementary tree and shrub planting.
Fragmentation (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat	As tree cover is naturally patchy within this community, the project is considered unlikely to modify the structure of the community to such a degree that its local occurrence would be fragmented or isolated from other areas of habitat.
Importance of Habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the community in the locality	Most of the trees that would be affected are juvenile to semi-mature or basal regrowth after recent fires. Several mature, healthy trees are likely to be removed from the southern quarter of Site 2 as well as two mature, healthy trees are likely to be removed from patches of this community. The groundcover vegetation that would be disturbed is moderately to heavily weed-infested with a low to moderate density and diversity of native species. This vegetation is considered to be of moderate condition. The proposed rehabilitation works are considered likely to result in the maintenance or improvement to the condition of the groundcover at the crossing locations.
Recovery Planning and Threat Abatement f) consistency with the objectives or actions of a recovery plan or threat abatement plan	No threat abatement plans of relevance to this species have been prepared. No recovery plan has been prepared for this species however recovery strategies and recovery actions have been identified. Most of these actions relate specifically to research and management actions undertaken by government bodies. The following recovery action is however considered to be of relevance to the project: Ensure Box-Gum Woodland is afforded high level of protection by relevant environmental management committees when developing environmental policy. In accordance with the principles of this strategy, the minimum practicable clearing of vegetation,

Box-Gum Woodland White Box Yellow Box Blakely's Red Gum Woodland	
Relevant criteria from s92 of the TSC Act	**Assessment of Impact**
	particularly mature and hollow-bearing trees, and native understorey vegetation would be undertaken. Replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves to compensate for tree losses.
Key Threatening Processes g) whether the action 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.	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees. The likely interaction between the project and these processes is detailed in Section 6.1. The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Appendix B Assessments of Impact on Commonwealth (EPBC Act) Listed Migratory Species likely to occur within the study area

The threatened flora and fauna species have been categorised into groups with broadly similar habitat requirements for the purpose of this assessment.

Table 28 Superb Parrot Polytelis Swainsonii

Superb Parrot Polytelis Swainsonii	
Impact Assessment Criteria*	**Assessment of Impact**
Lead to a long-term decrease in the size of a population	Potential foraging habitat for this species in the form of native groundcover, shrub patches and woodland canopy would be modified however this modification is not considered likely to substantially alter the value of these areas to the species.
Reduce the area of occupancy of the species	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Fragment an existing population into two or more populations	The habitat that occurs within the road reserves and around the Ulandra and Billabung Creek areas is considered likely to be of high importance for the conservation and recovery of the species in the locality as these areas provide the most suitable foraging and potential breeding habitat. The value of these areas is however considered unlikely to be significantly modified by the proposal.
Adversely affect habitat critical to the survival of a species	The following recovery action is considered to be of relevance to the project: No loss of known or potential box-gum foraging habitat. In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, and native understorey vegetation would be undertaken. Replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves.
Disrupt the breeding cycle of a population	Two known hollow-bearing trees, containing four hollows, would be removed from the woodland of the road reserve at Site 5. Some of the approximately 50 isolated paddock trees that would be removed may contain suitable nesting habitat for this species.
Result in invasive species that are harmful to vulnerable species becoming established in the vulnerable species habitat	The proposed action is a duplication of an existing pipeline. The use of the land will not change and therefore the risk of introducing invasive species remains as it is currently.
Introduce disease that may cause the species to decline	The proposed action is a duplication of an existing pipeline. The use of the land will not change and therefore the risk of introducing disease remains as it is currently.
Interfere substantially with the recovery of a species	The proposed works may contribute to the following threatening processes: Invasion of native plant communities by exotic perennial grasses Clearing of native vegetation Loss of Hollow-bearing Trees Removal of dead wood and dead trees.

Superb Parrot Polytelis Swainsonii	
Impact Assessment Criteria*	**Assessment of Impact**
	The project is not considered likely to substantially increase the impact of these processes on the threatened species and ecological communities of the study area.

Table 29 Swift Parrot Lathamus discolor

Swift Parrot Lathamus discolor	
Impact Assessment Criteria*	**Assessment of Impact**
Lead to a long-term decrease in the size of a population	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. The woodland of the study area provides a potential food source for this species however, due to the relatively small extent and fragmentation of this habitat, the species is only considered likely to forage here on a sporadic basis.
Reduce the area of occupancy of the species	Approximately 4.0 hectares of Box Gum Woodland, including an area of approximately 3.0 hectares based around Site 2, as well as some of the approximately 50 isolated paddock trees that would be removed, may be used as foraging habitat by this species.
Fragment an existing population into two or more populations	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Adversely affect habitat critical to the survival of a species	The habitat of the road reserves and around Ulandra and Billabung Creeks is considered likely to be of moderate importance for the conservation and recovery of the species in the locality as these areas provide the most suitable foraging habitat yet are likely to be used on a sporadic basis. Overall, the value of these areas to the species is considered unlikely to be significantly modified by the proposal.
Disrupt the breeding cycle of a population	This species migrates to the Australian south-east mainland between March and October from its breeding distribution in Tasmania. It does not breed on the mainland.
Result in invasive species that are harmful to vulnerable species becoming established in the vulnerable species habitat	The proposed action is a duplication of an existing pipeline. The use of the land will not change and therefore the risk of introducing invasive species remains as it is currently.
Introduce disease that may cause the species to decline	The proposed action is a duplication of an existing pipeline. The use of the land will not change and therefore the risk of introducing disease remains as it is currently.
Interfere substantially with the recovery of a species	Enhance habitat for Swift Parrots by planting suitable tree species to complement natural regeneration or to enhance remnants In accordance with the principles of this strategy, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, and native understorey vegetation would be undertaken. Replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves to compensate for tree losses

Table 30 Reagent Honeyeater Xanthomyza phrygia

Reagent Honeyeater Xanthomyza phrygia	
Impact Assessment Criteria*	**Assessment of Impact**
Lead to a long-term decrease in the size of a population	The woodland of the study area provides a potential food source for this species however, due to the relatively small extent and fragmentation of this habitat, and its distance from key breeding regions the species is only considered likely to forage here on a sporadic basis.
Reduce the area of occupancy of the species	The approximately 4.0 hectares of woodland and some of the approximately 50 isolated paddock trees that would be removed may be used as foraging habitat by this species.
Fragment an existing population into two or more populations	Due to the small amount of habitat removed at each road and waterway crossing and the ability of the species to fly considerable distances whilst foraging, the removal of trees and control of tree regrowth is considered unlikely to significantly affect the movement of the species or cause an area of habitat is likely to become fragmented or isolated from other areas of habitat.
Adversely affect habitat critical to the survival of a species	The habitat of the road reserves and Ulandra and Billabung Creeks is considered likely to be of moderate importance for the conservation and recovery of the species in the locality as these areas provide the most suitable foraging habitat yet are likely to be used on a sporadic basis. The value of these areas to the species is considered unlikely to be significantly modified by the proposal.
Disrupt the breeding cycle of a population	There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years non-breeding flocks converge on flowering coastal woodlands and forests.
Result in invasive species that are harmful to vulnerable species becoming established in the vulnerable species habitat	The proposed action is a duplication of an existing pipeline. The use of the land will not change and therefore the risk of introducing invasive species remains as it is currently.
Introduce disease that may cause the species to decline	The proposed action is a duplication of an existing pipeline. The use of the land will not change and therefore the risk of introducing disease remains as it is currently.
Interfere substantially with the recovery of a species	The following recovery objectives are considered to be of relevance to the project: Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites. In accordance with this objective, the minimum practicable clearing of vegetation, particularly mature and hollow-bearing trees, and native understorey vegetation would be undertaken and replanting of native groundcover vegetation would be conducted within and adjacent to road crossing locations. Trees and shrubs would also be planted in nearby open areas of road reserves to compensate for tree losses.

Table 31 Migratory Species

Migratory Species Hirundapus caudacutus (White-throated Needletail), Merops ornatus (Rainbow Bee-eater), Lathamus discolor (Swift Parrot) Xanthomyza phrygia (Regent Honeyeater), and	
Impact Assessment Criteria*	**Assessment of Impact**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Each of these species occupies a broad range of vegetation types including the woodland, open grassland and ephemeral water bodies found throughout the study area. Disturbance to these areas, including the removal of mature trees, is unlikely to have any significant impact on any of these species. This is based on the wide distribution that these species are believed to have throughout the area.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or	The location of the proposed action will not occur within any known habitat with the establishment of any invasive species which may be harmful to these species unlikely.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of a migratory species.	Each of these species may potentially occupy a broad range of vegetation types including the woodland, open grassland and ephemeral water bodies found throughout the study area. Disturbance to these areas, including the removal of isolated paddock trees as well as those located within road reserves and along creek lines, is unlikely to have any significant impact on any of these species. This is based on the minimal disturbance likely to result from the works as well as the wide distribution that these species are believed to have throughout the area.

Table 32 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	
Impact Assessment Criteria*	**Assessment of Impact**
Reduce the extent of an ecological community	Disturbance to approximately 4.0 hectares of this community over six locations, followed by restoration of native groundcover vegetation and supplementary tree and shrub planting is unlikely to result in a reduction in the extent of this community.
Fragment or increase	As tree cover is naturally patchy within this community, the project is considered unlikely to modify the structure of the community to

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	
Impact Assessment Criteria*	**Assessment of Impact**
fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	such a degree that its local occurrence would be fragmented or isolated from other areas of habitat.
Adversely affect habitat critical to the survival of an ecological community	The modification to habitat, including vegetation structure, caused over a very limited area at each site is unlikely to cause the community to be placed at increased risk of extinction.
Modify or destroy abiotic (non living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival.	The proposed action involves the construction of similar pipeline infrastructure within the currently maintained easement. Because the land use is effectively unchanged from the present, it is not expected to significantly alter the existing abiotic factors which currently exist within the area. The existing surface water drainage will remain at it is at present.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species.	Most of the trees that would be affected are juvenile to semi-mature or basal regrowth after recent fires. Several mature, healthy trees are likely to be removed from the southern quarter of Site 2. The groundcover vegetation that would be disturbed is moderately to heavily weed-infested with a low to moderate density and diversity of native species. This vegetation is considered to be of moderate condition. The proposed rehabilitation works are considered likely to result in the maintenance or improvement to the condition of the groundcover at the crossing locations.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community but not limited to; Assisting invasive species, that are harmful to the listed ecological community, to become established; and Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit growth of species in the ecological	The proposed works will not substantially reduce any areas of that contain this ecological community. Those areas containing the ecological community that the proposed works pass through, such as road crossings, extend beyond the narrow, linear construction footprint. Construction management strategies will be developed in support of the environmental assessment. Invasive species will be managed as part of the normal asset management practices.

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	
Impact Assessment Criteria*	**Assessment of Impact**
community	
Interfere with the recovery of an ecological community	The combined footprint impacted by the proposed works, which includes road crossing and the larger area around Site 2, covers an area of approximately 4.0 hectares. Whilst the removal of large hollow bearing trees should be avoided where possible through suitable construction techniques, due to the generally open structure of this woodland community it is expected that the action will not interfere with the recovery of this community.

Appendix C Detailed Survey Site Figures and Photographs

Site 1

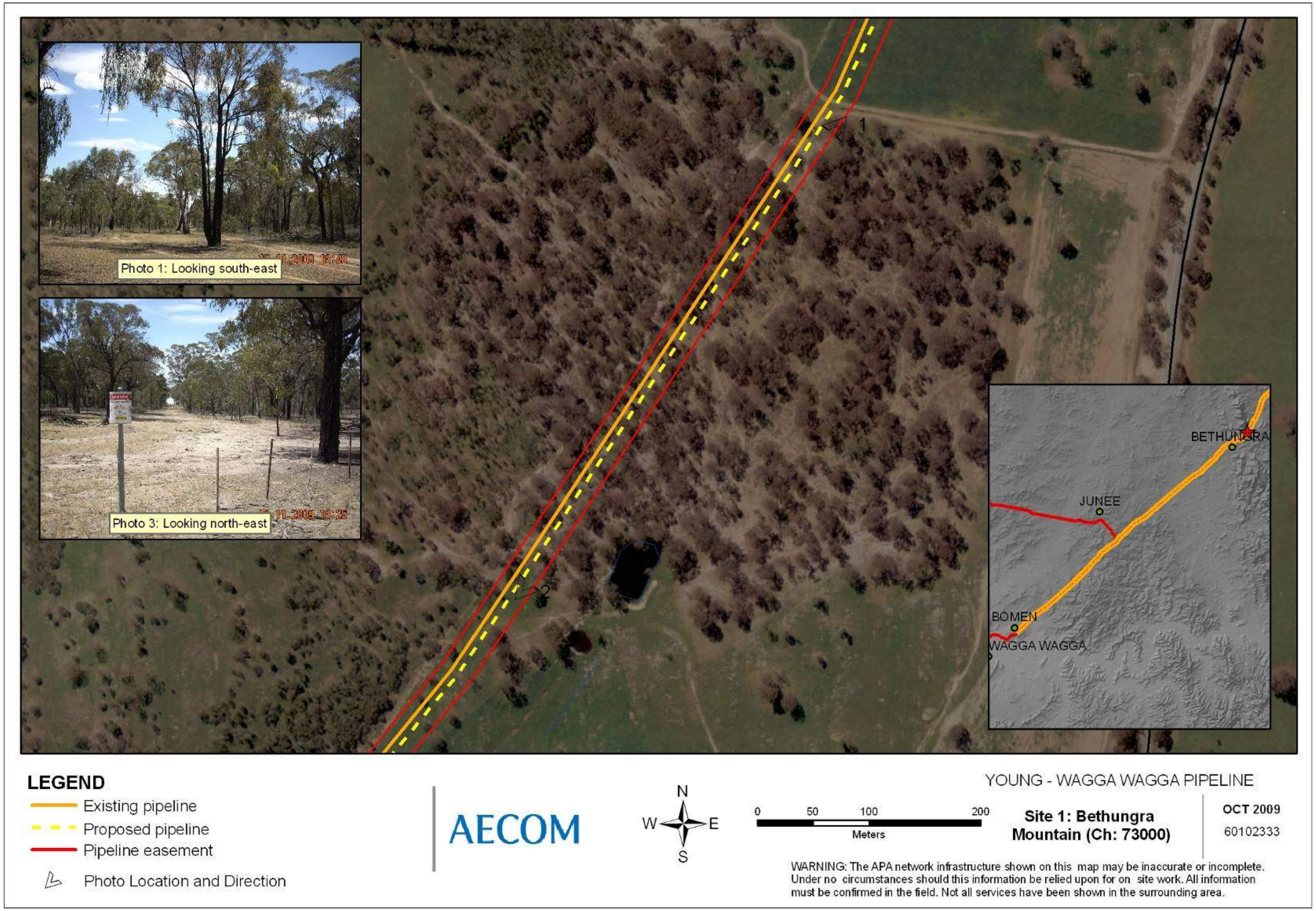


Photo 1: Looking south-east
Photo 3: Looking north-east
1
2
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
AECOM
N
W
E
S
0
50
100
200
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 1: Bethungra Mountain (Ch: 73000)
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Site 2

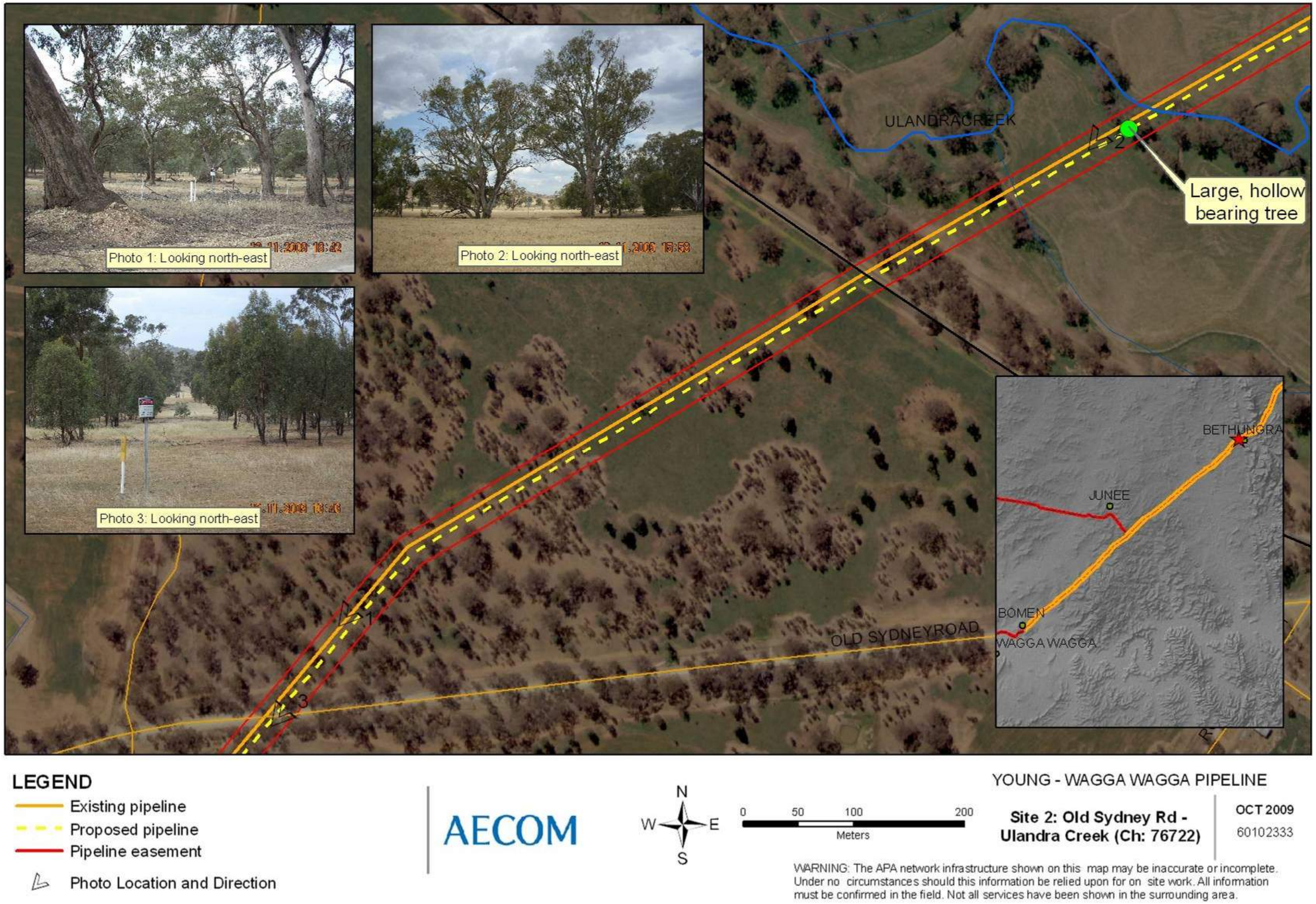


Photo 1: Looking north-east
Photo 2: Looking north-east
Photo 3: Looking north-east
ULANDRA CREEK
Large, hollow bearing tree
OLD SYDNEY ROAD
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
AECOM
N
S
W
E
0
50
100
200
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 2: Old Sydney Rd - Ulandra Creek (Ch: 76722)
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Site 3

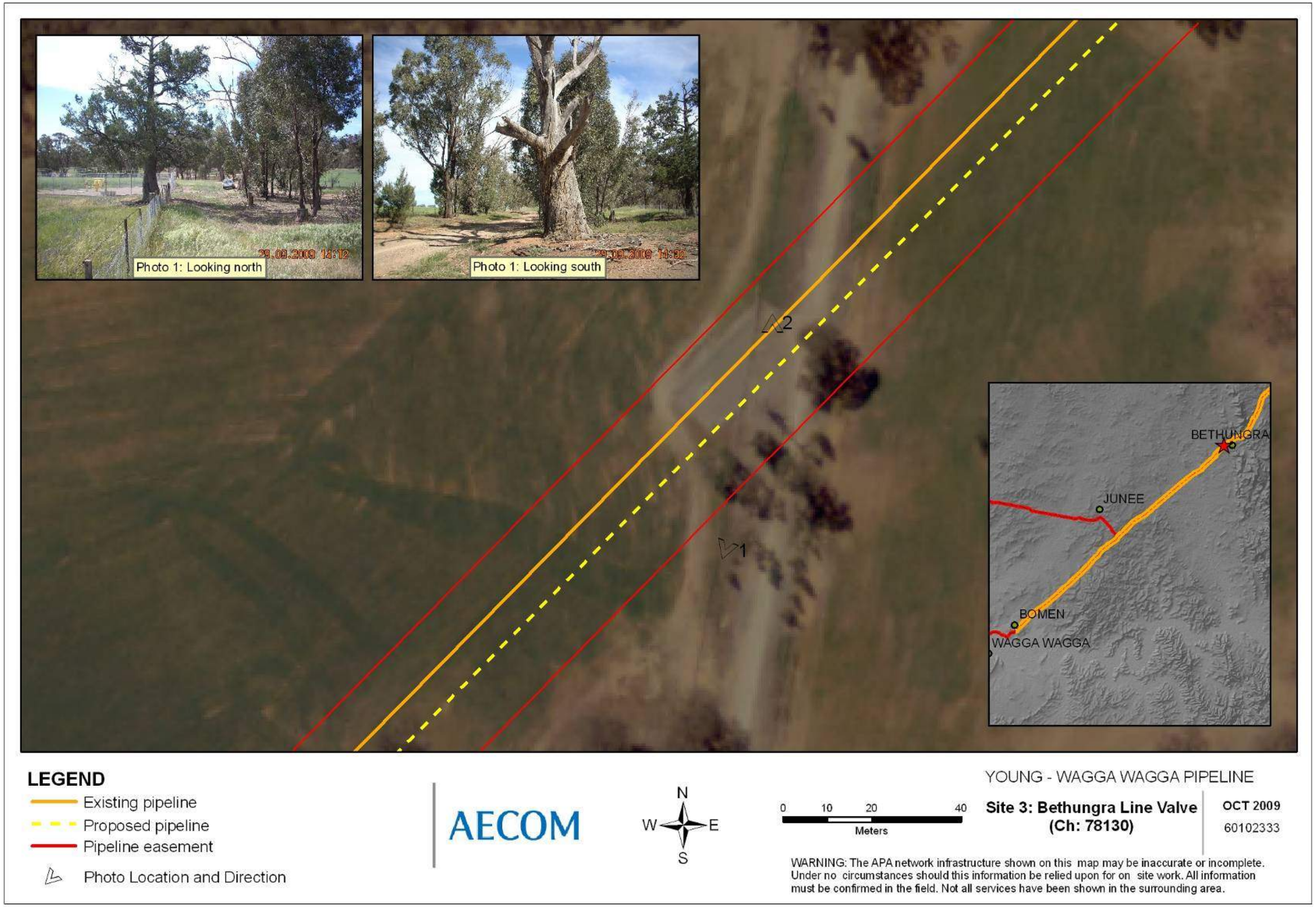


Photo 1: Looking north
Photo 1: Looking south
2
1
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
AECOM
N
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E
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0 10 20 40
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 3: Bethungra Line Valve (Ch: 78130)
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Site 4

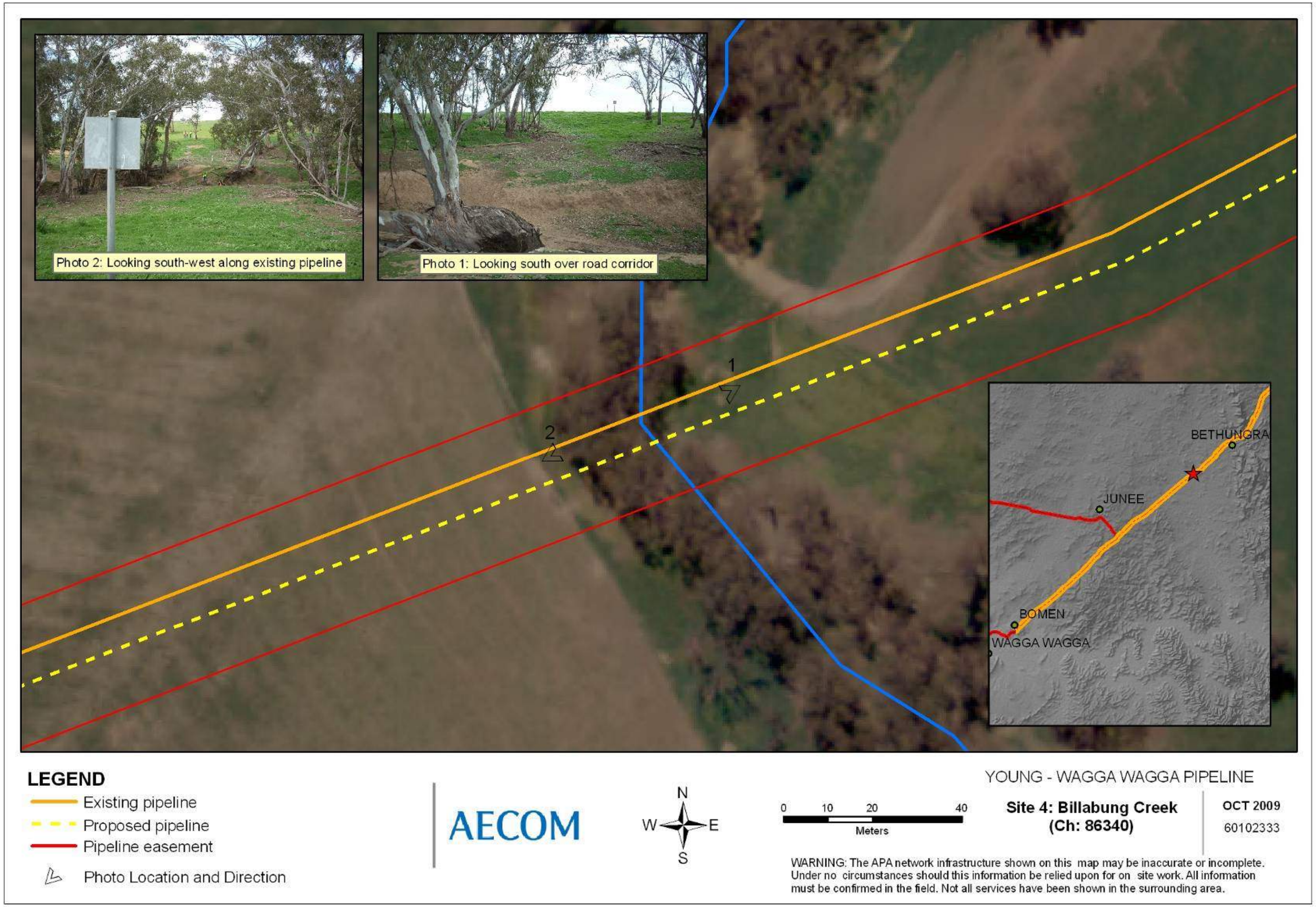
Photo 2: Looking south-west along existing pipeline
Photo 1: Looking south over road corridor
1
2
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
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0 10 20 40
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 4: Billabung Creek
(Ch: 86340)
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Site 5

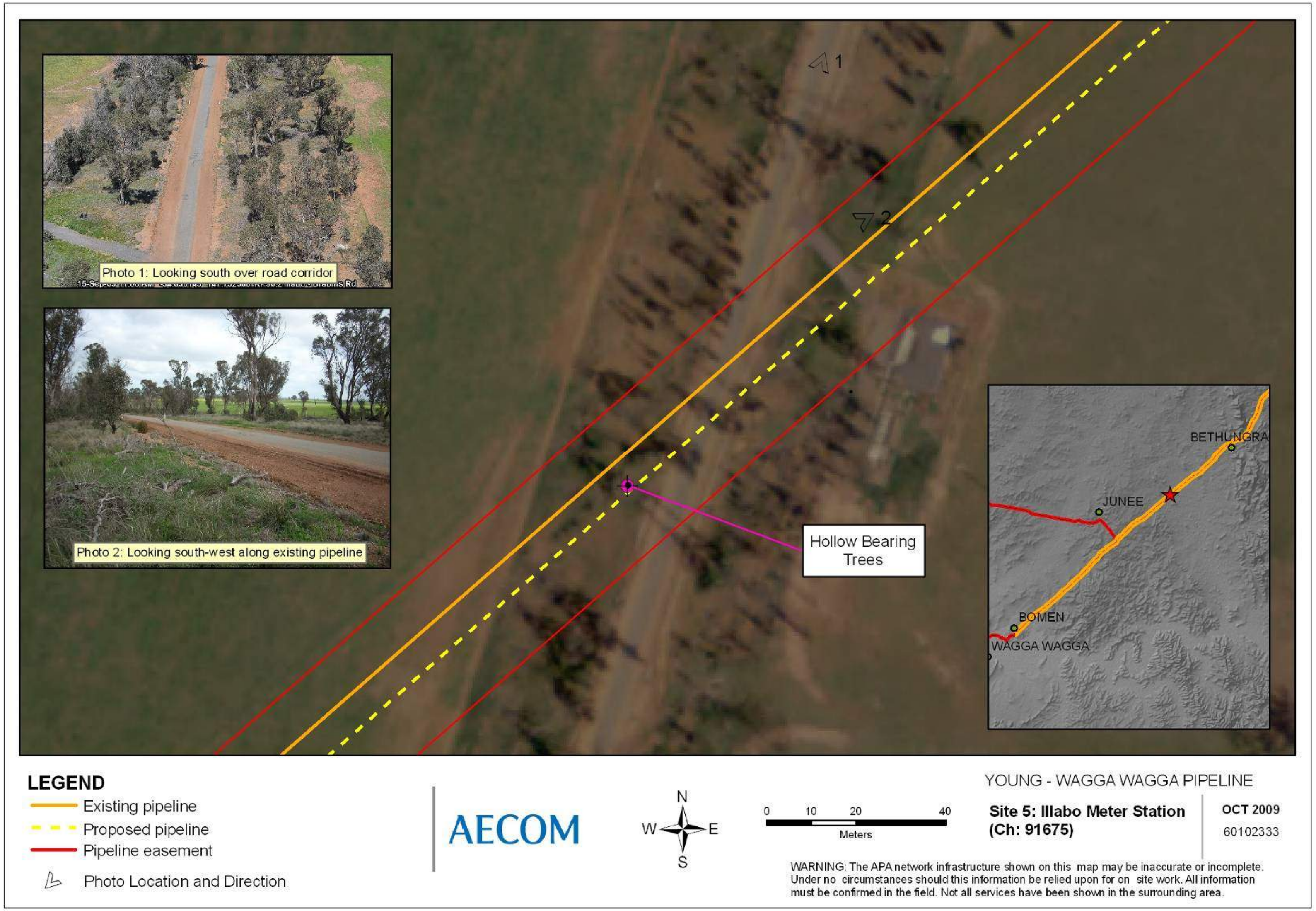
Photo 1: Looking south over road corridor
Photo 2: Looking south-west along existing pipeline
1
2
Hollow Bearing Trees
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
AECOM
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40
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 5: Illabo Meter Station (Ch: 91675)
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Site 6

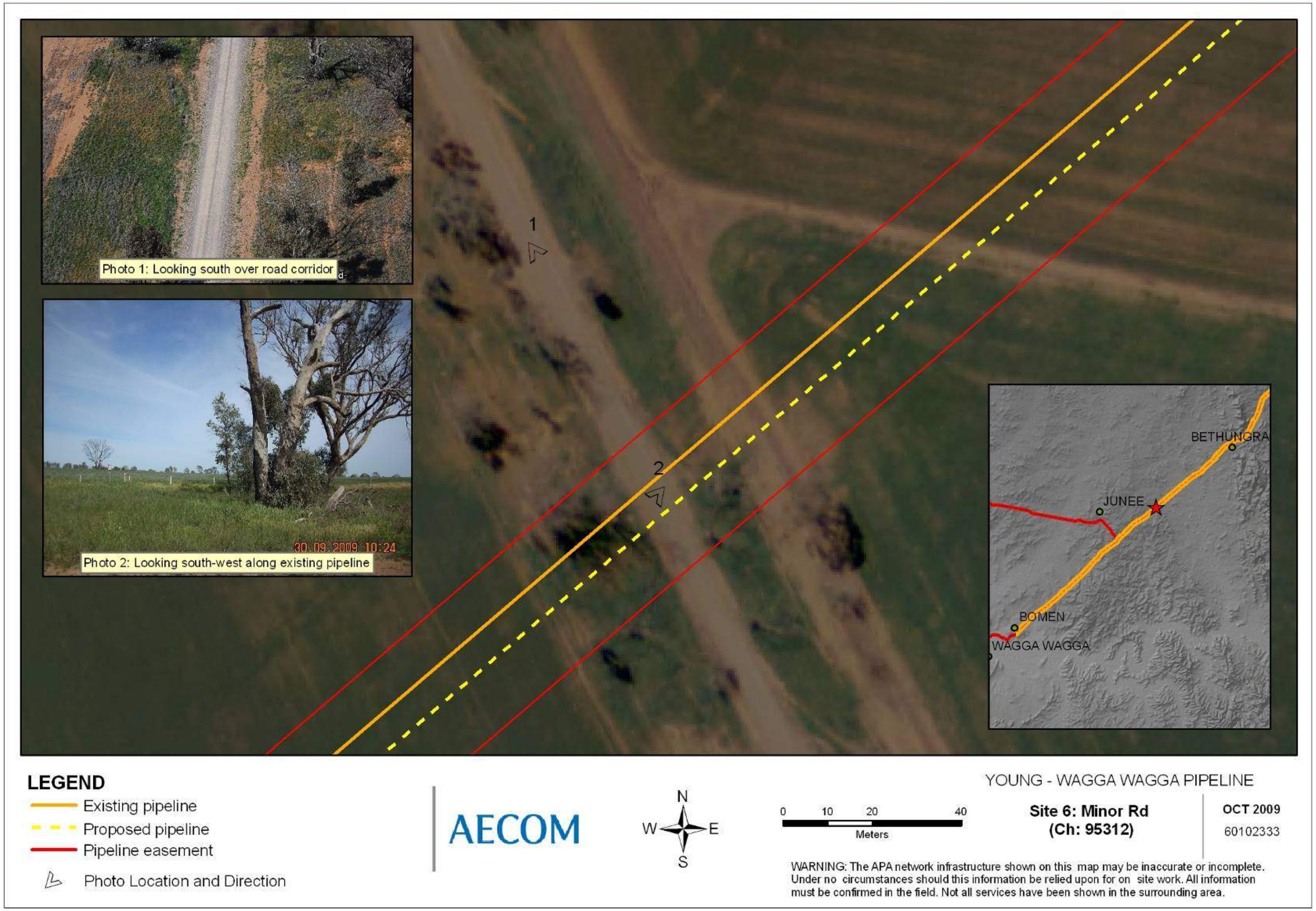
Photo 1: Looking south over road corridor
30.09.2009 10:24
Photo 2: Looking south-west along existing pipeline
1
2
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
AECOM
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0
10
20
40
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 6: Minor Rd
(Ch: 95312)
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Site 7

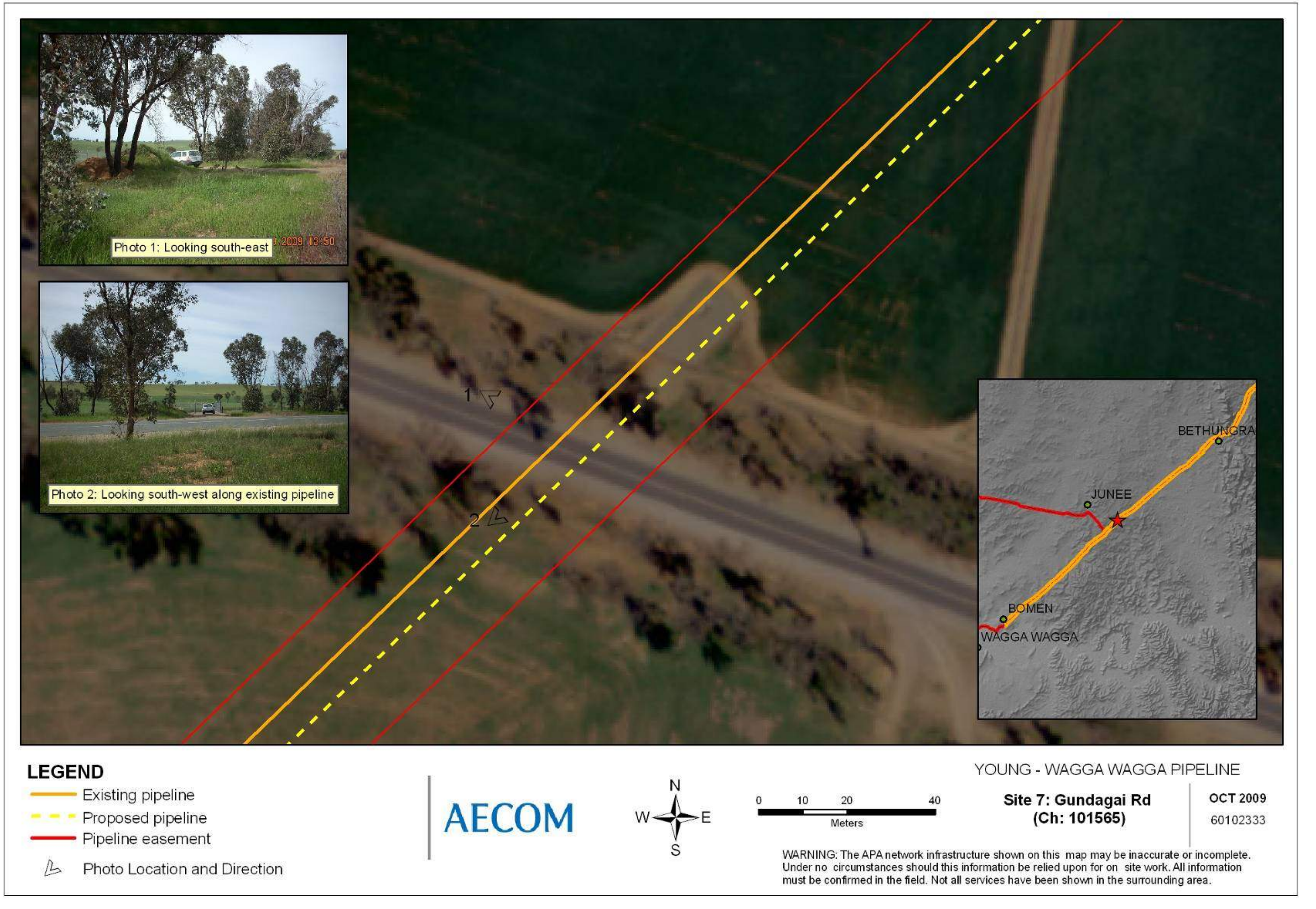
Photo 1: Looking south-east
Photo 2: Looking south-west along existing pipeline
1
2
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
AECOM
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0 10 20 40
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 7: Gundagai Rd
(Ch: 101565)
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Site 8

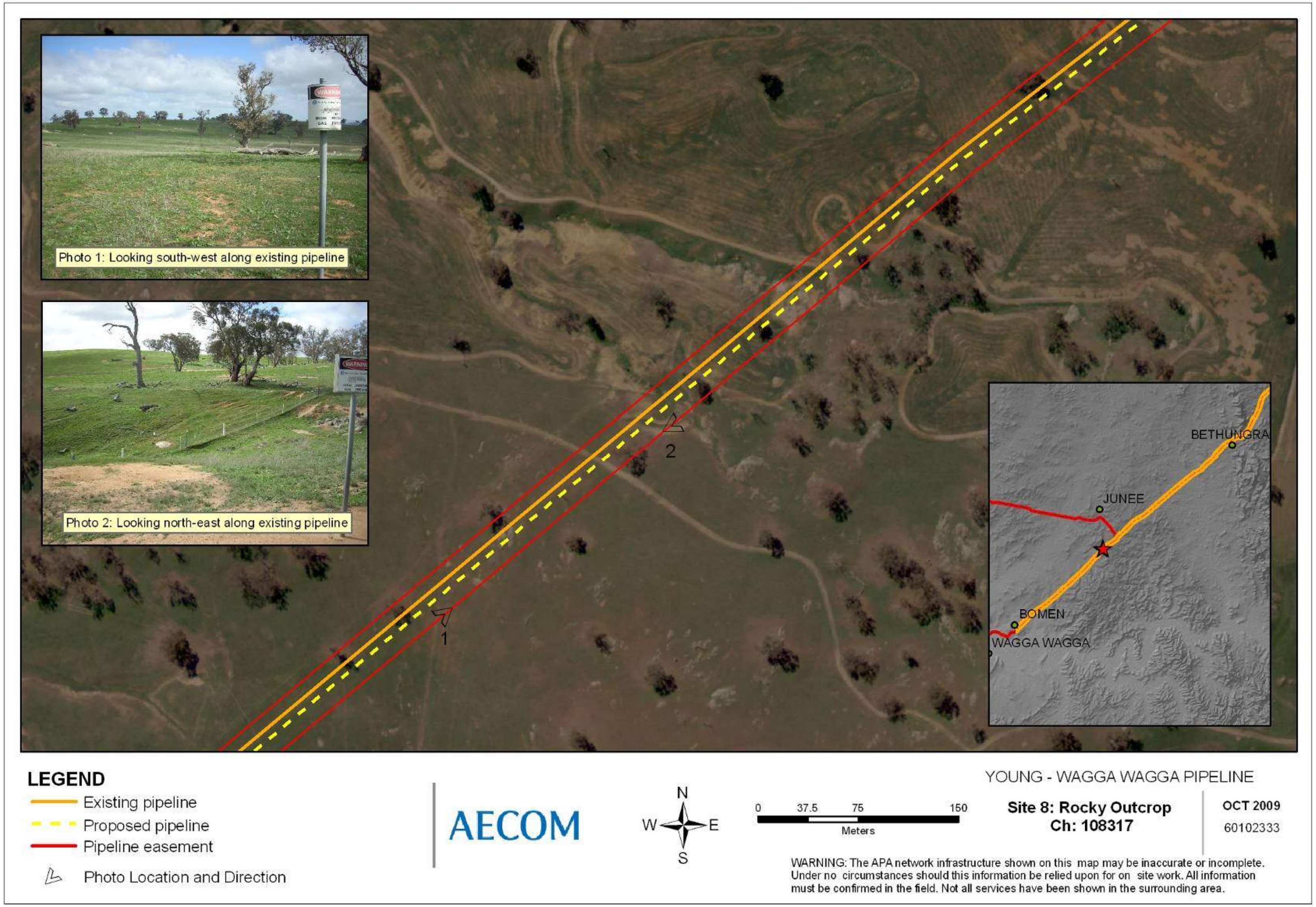
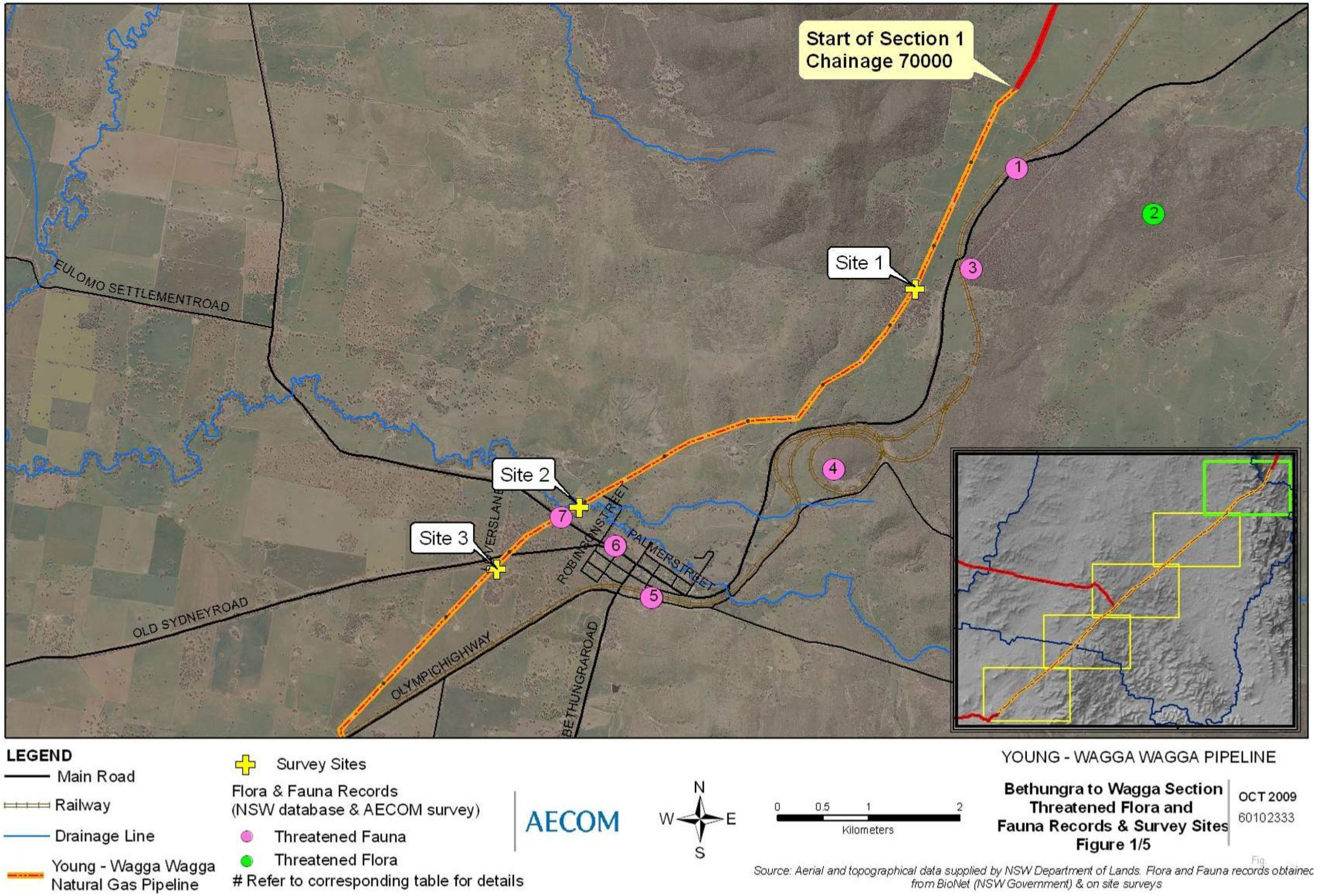


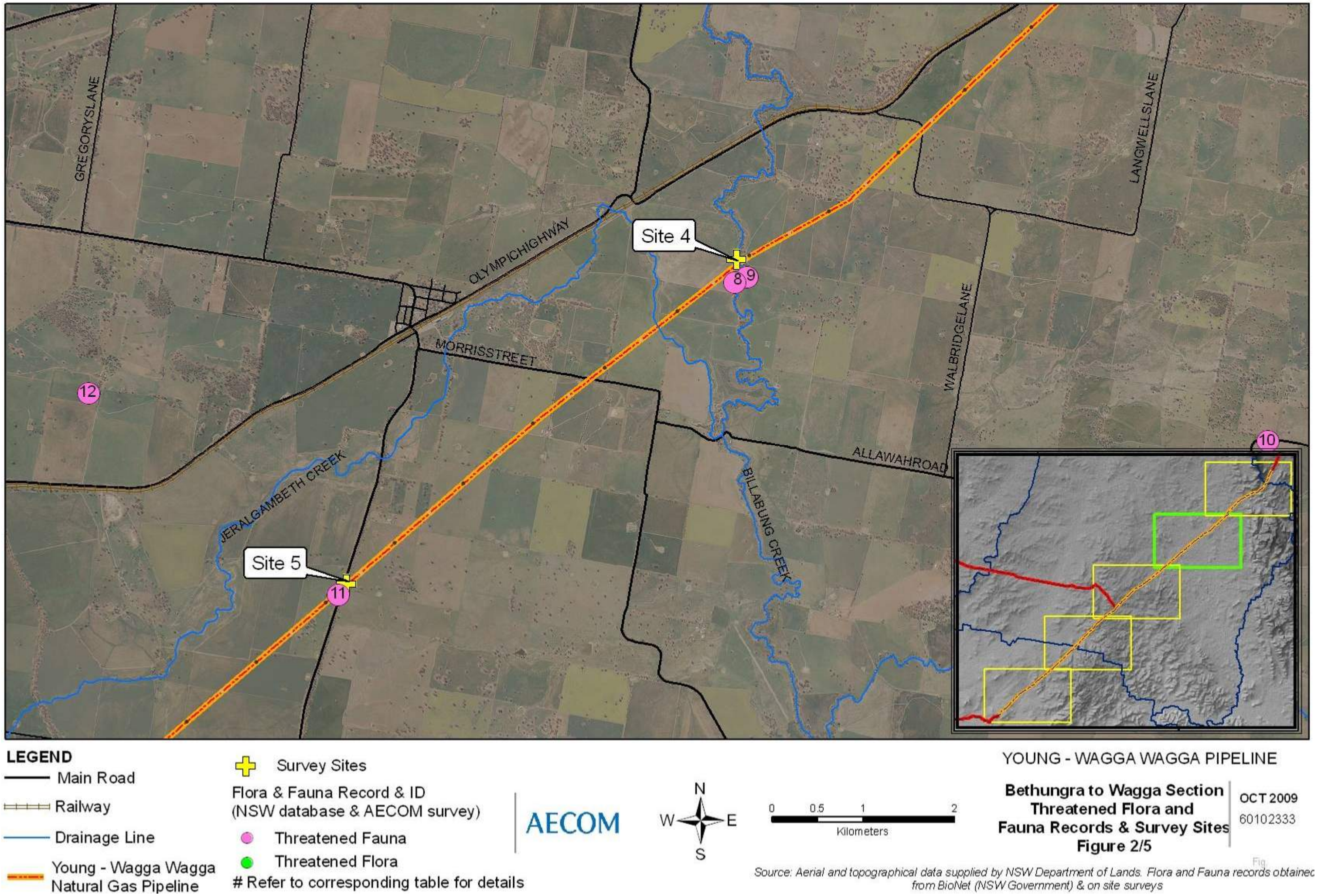
Photo 1: Looking south-west along existing pipeline
Photo 2: Looking north-east along existing pipeline
1
2
BETHUNGRA
JUNEE
BOMEN
WAGGA WAGGA
LEGEND
Existing pipeline
Proposed pipeline
Pipeline easement
Photo Location and Direction
AECOM
N
W
E
S
0
37.5
75
150
Meters
YOUNG - WAGGA WAGGA PIPELINE
Site 8: Rocky Outcrop
Ch: 108317
OCT 2009
60102333
WARNING: The APA network infrastructure shown on this map may be inaccurate or incomplete. Under no circumstances should this information be relied upon for on site work. All information must be confirmed in the field. Not all services have been shown in the surrounding area.

Appendix G Overview – Study Area & Flora and Fauna Records

Bethungra area



Illabo area


GREGORYSLANE
LANGWELLSLANE
OLYMPICHIGHWAY
MORRISSTREET
WALBRIDGELANE
ALLAWAHROAD
JERALGAMBETH CREEK
BILLABUNG CREEK
Site 4
Site 5
8
9
10
11
12
LEGEND
Main Road
Railway
Drainage Line
Young - Wagga Wagga Natural Gas Pipeline
Survey Sites
Flora & Fauna Record & ID (NSW database & AECOM survey)
Threatened Fauna
Threatened Flora
Refer to corresponding table for details
AECOM
N
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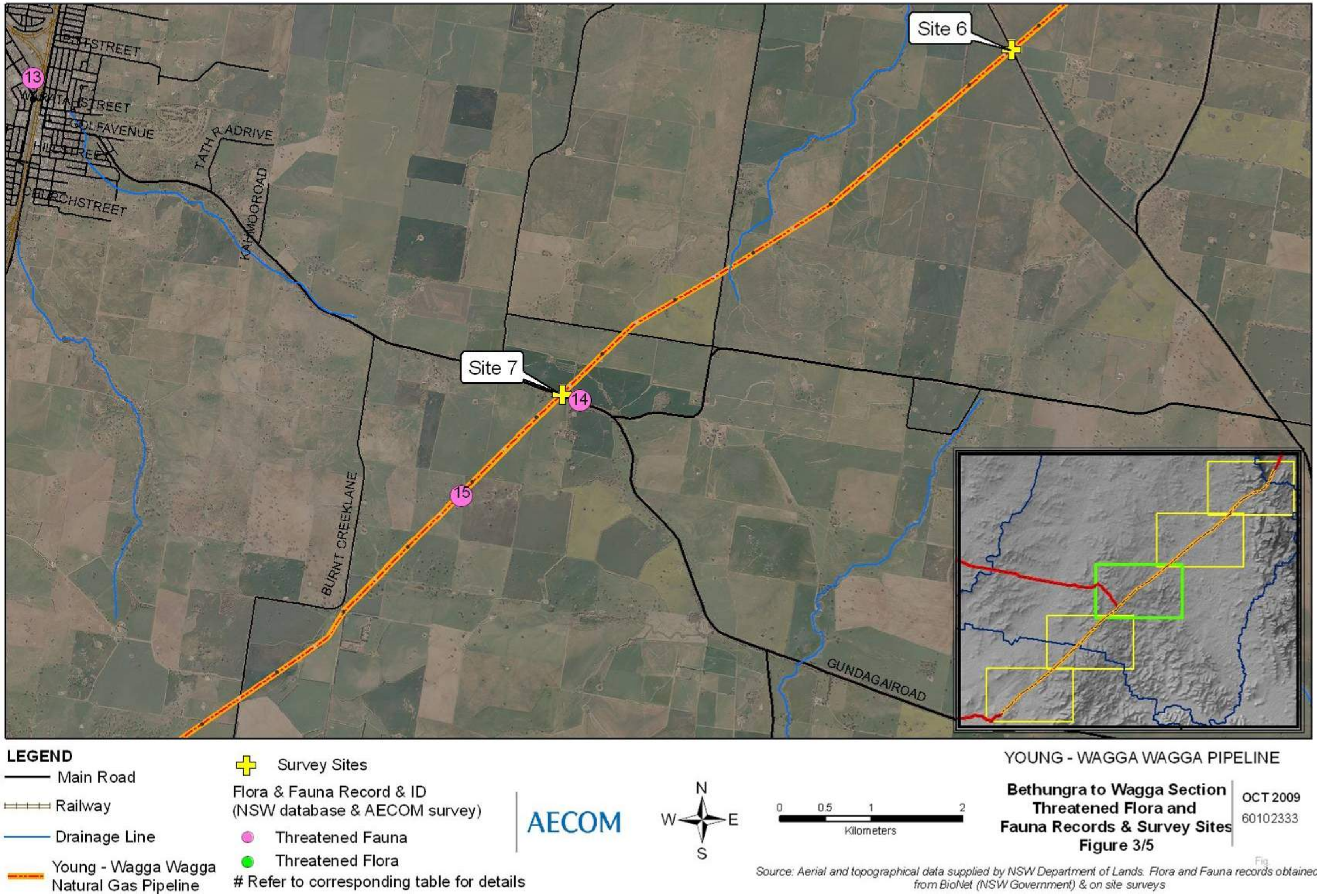
0.5
1
2
Kilometers
YOUNG - WAGGA WAGGA PIPELINE
Bethungra to Wagga Section
Threatened Flora and
Fauna Records & Survey Sites
Figure 2/5
OCT 2009
60102333
Source: Aerial and topographical data supplied by NSW Department of Lands. Flora and Fauna records obtained from BioNet (NSW Government) & on site surveys

Wantiool area



Harefield area

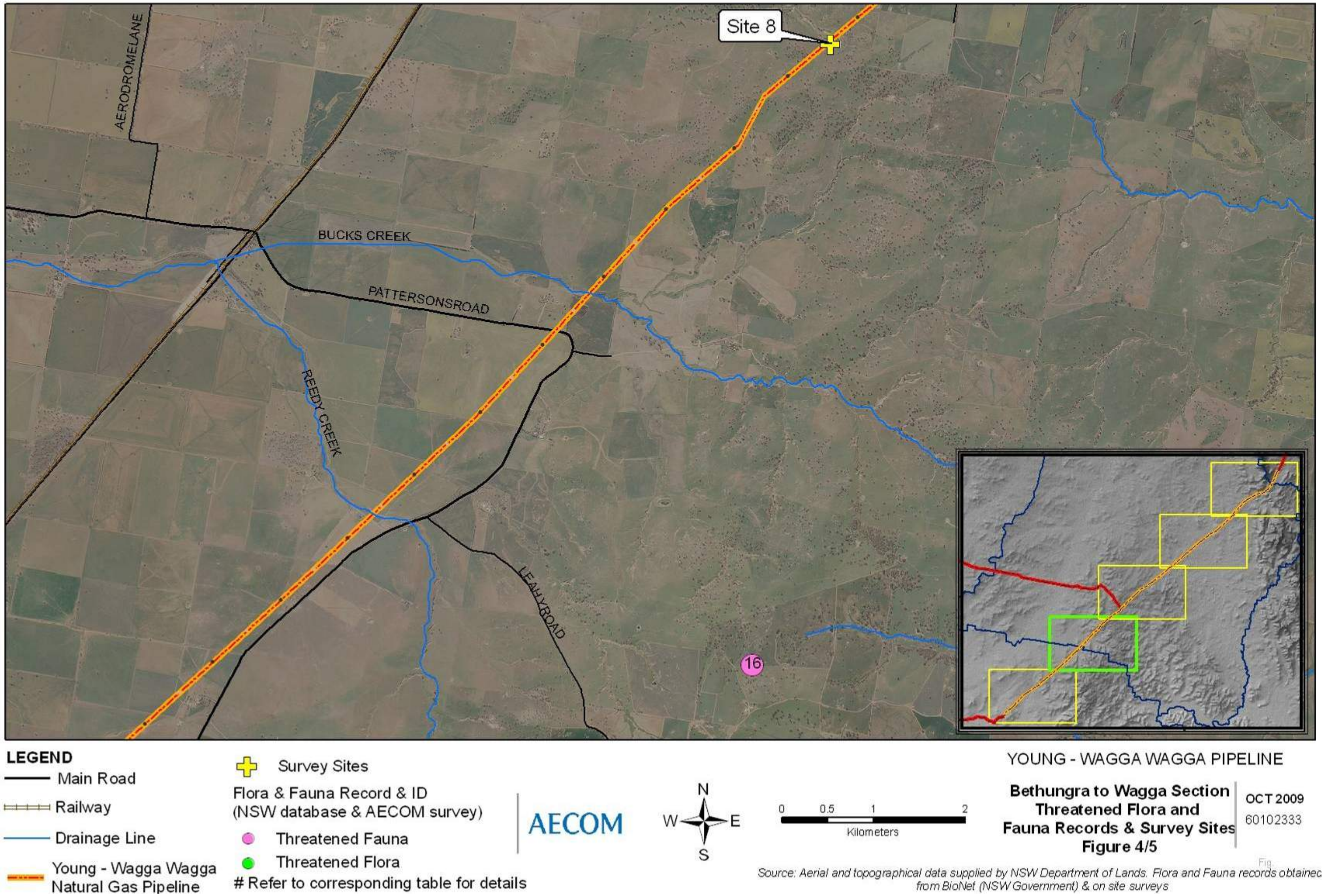


Figure 4 – Bomen area

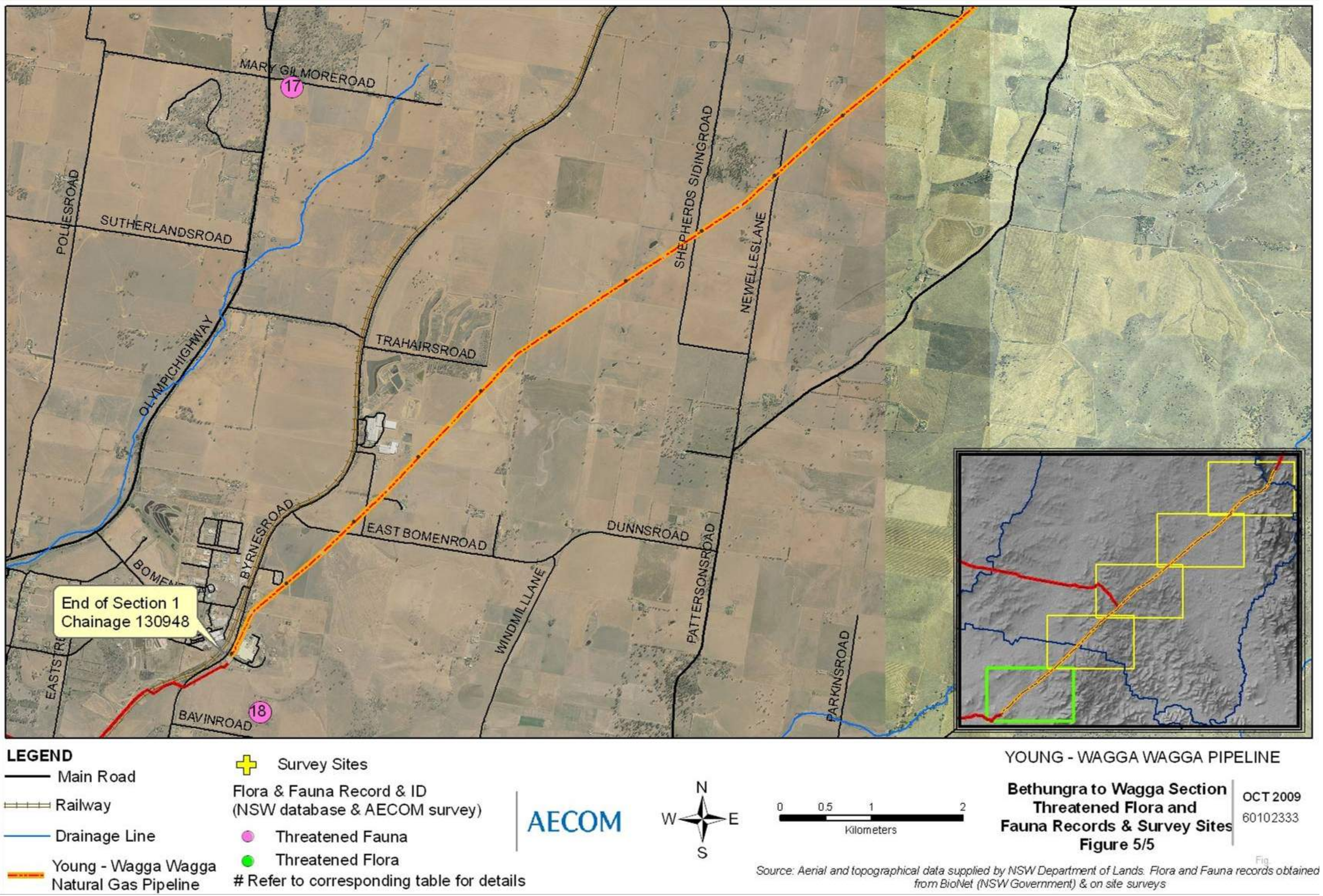


Table 33 Threatened species observations near the Young – Wagga Wagga natural gas pipeline

Site ID	Common Name	Scientific Name	Date Recorded	No. of Specimens	Source
1	Superb Parrot	Polytenis swainsonii	26/10/2001	2	NSW Database
1	Painted Honeyeater	Grantiella picta	26/10/2001	6	NSW Database
2	Sand-hill Spider Orchid	Caladenia arenaria	29/09/1990	1	NSW Database
3	Superb Parrot	Polytenis swainsonii	28/10/2001	8	NSW Database
4	Brown Treecreeper	Climateris picumnus	30/07/1978	1	NSW Database
4	Brown Treecreeper	Climateris picumnus	29/04/1979	1	NSW Database
4	Speckled Warbler	Pyrrholaemus sagittatus	30/07/1978	1	NSW Database
5	Superb Parrot	Polytenis swainsonii	15/12/1970	8	NSW Database
5	Brown Treecreeper	Climateris picumnus	22/06/1968	1	NSW Database
5	Brown Treecreeper	Climateris picumnus	13/05/1969	1	NSW Database
5	Brown Treecreeper	Climateris picumnus	16/05/1969	1	NSW Database
5	Brown Treecreeper	Climateris picumnus	29/12/1969	1	NSW Database
5	Brown Treecreeper	Climateris picumnus	15/12/1970	1	NSW Database
5	Brown Treecreeper	Climateris picumnus	24/05/1971	1	NSW Database
5	Brown Treecreeper	Climateris picumnus	25/04/1973	1	NSW Database
5	Black-chinned Honeyeater	Melithreptus gularis	24/05/1971	1	NSW Database
5	Regent Honeyeater	Xanthomyza phrygia	24/05/1971	1	NSW Database
6	Superb Parrot	Polytenis swainsonii	22/10/1978	1	NSW Database
6	Turquoise Parrot	Neophema pulchella	24/01/1975	1	NSW Database
6	Brown Treecreeper	Climateris picumnus	24/01/1975	1	NSW Database
6	Brown Treecreeper	Climateris picumnus	22/10/1977	1	NSW Database
6	Speckled Warbler	Pyrrholaemus sagittatus	24/01/1975	1	NSW Database
6	Speckled Warbler	Pyrrholaemus sagittatus	4/05/1985	1	NSW Database
6	Hooded Robin	Melanodryas cucullata	10/04/1991	1	NSW Database
6	Diamond Firetail	Stagonopleura guttata	2/04/1987	1	NSW Database
7	Brown Treecreeper	Climateris picumnus	13/11/2009	1	AECOM Survey
7	Barking Owl	Ninox connivens	13/11/2009	2	AECOM Survey
8	Brown Treecreeper	Climateris picumnus	1/10/2009	2	AECOM Survey
9	Superb Parrot	Polytenis swainsonii	1/10/2009	2	AECOM Survey
10	Brown Treecreeper	Climateris picumnus	15/01/1999	1	NSW Database
11	Superb Parrot	Polytenis swainsonii	30/09/2009	2	AECOM Survey
12	Grey-crowned Babbler	Pomatostamus temporalis	22/10/1972	1	NSW Database
13	Regent Honeyeater	Xanthomyza phrygia	15/10/1997	1	NSW Database
14	White-browed Woodswallow	Artamus superciliosus	31/09/2009	10	AECOM Survey
15	Brown Treecreeper	Climateris picumnus	12/07/1969	1	NSW Database
16	Bilby	Macrotis lagotis	31/12/1886	1	NSW Database
17	Superb Parrot	Polytenis swainsonii	17/07/2001	5	NSW Database
18	Superb Parrot	Polytenis swainsonii	19/11/1993	1	NSW Database
18	Brown Treecreeper	Climateris picumnus	28/09/1993	1	NSW Database

Appendix E

Heritage Assessment

FINAL

Heritage Assessment

Stage 1 - Bethungra to Wagga Wagga

Heritage Assessment

Heritage Assessment: Stage 1 - Bethungra to Wagga Wagga

Prepared for

APA Group Pty Ltd

Prepared by

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29 January 2010

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Heritage Assessment

Stage 1 - Bethungra to Wagga Wagga

Prepared for

APA Group Pty Ltd

Prepared by

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ABN 20 093 846 925

29 January 2010

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Date	29 January 2010
Prepared by	Rick Bullers Author Signature
Reviewed by	Neville Baker Technical Peer Reviewer Signature

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Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature

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Glossary of Terms

Activity Area	A pattern of artefacts in a site indicating that a specific activity took place.
Adaptation	Adaptation means modifying a place to suit proposed compatible uses.
Alluvial	Pertaining to sediment mass deposited from transport by channelled stream flow or over-bank stream flow.
Anvil	Object that supports a stone artefact that is being struck with a hammer.
Archaeological Potential	The likelihood of the presence of archaeological evidence ascertained through physical evaluation (survey, test excavations) and historical research.
Artefact Scatter	A collection of artefacts usually distributed across the surface of the ground.
Aboriginal Object	*'…any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains'* (s.5 NPW Act)
Aboriginal Place	Any place declared to be an Aboriginal place under s.84 of the *National Parks and Wildlife Act 1974* (NPW Act) because the place is or was of special significance with respect to Aboriginal culture. It may or may not contain Aboriginal objects.
Aboriginal Scarred Tree	A tree that bears a scar or scars which are wounds formed from the deliberate removal of bark or wood by Aboriginal people. Aboriginal scarred trees are often an indicator of an activity area.
Aboriginal Site	In this study, the term is used to define the present physical extent of visible Aboriginal archaeological material.
Artefact	Any object which is physically modified by humans.
Assemblage	A collection of artefacts associated by a particular place or time and assumed generated by a single group of people. An assemblage can comprise different artefact types.
Attribute	A well defined feature of an artefact that cannot be further subdivided. Archaeologists identify types of attributes, including form, style and technology, in order to classify and interpret artefacts.
Axe	A stone-headed axe characteristically containing two ground surfaces which meet at a bevel.
Backed Artefact	A stone tool where one margin of a flake is retouched at a steep angle and that margin is opposite a sharp edge.
Background Scatter	A term sometimes used to describe a low density scatter of isolated finds that are distributed through the landscape without any obvious focal point.
Basalt	Igneous volcanic rock sometimes used to make stone artefacts, although it is often unsuitable for stone implement production. Basalt is common in eastern Australia where there has been recent volcanic activity.
Bipolar Flake	A stone artefact made by striking into an anvil with a hammerstone. Bipolar flakes display crushing at either end.
Blade	A flake that is at least twice as long as it is wide.
Bondi Point	A small asymmetrical backed artefact with a point at one end and backing retouch.
Burin	A stone tool flaked on one or both ends to form a small chisel or grooving tool.

Burra Charter	The Burra Charter provides guidance for the conservation and management of places of cultural significance Australia. It sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance, including owners, managers and custodians. The most recent version of the Burra Charter was adopted by Australia ICOMOS (the Australian National Committee of ICOMOS) on 26 November 1999.
Chert	A crypto-crystalline sedimentary siliceous rock commonly used in the manufacture of stone implements.
Conjoin	A physical link between artefacts broken in antiquity.
Conjoin Set	A number of artefacts refitted together.
Conservation	As defined in The Burra Charter, conservation means all the processes of looking after a place so as to retain its cultural significance.
Conservation Area	A defined area of the landscape conserved in perpetuity for the management of the heritage values of that landscape.
Conservation Management Plan	A document that outlines the cultural heritage significance of an object or area and policies, guidelines, maintenance and strategies for the conservation of the object or area.
Contact Site	A site that displays an interaction between early colonists and Aboriginal Australians.
Core	A piece of flaked stone which has one or more negative flake scars but no positive flake scars.
Cortex	Weathered outer surface of a rock, usually chemically altered.
Country	A term used by Aboriginal people to refer to the land to which they belong.
Cultural significance	Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations (Australia ICOMOS Burra Charter Article 1.2).
Datum	The datum point is the location from which all measurements on a site are made. The datum point is tied into local survey maps.
Desktop Survey	A study that does not involve any field-based activity and only involves background research and reporting.
Diffusion	The spread of a cultural trait from one area to another by means of contact between people.
Distal	The terminating end of a flake opposite the bulb.
Edge Damage	The removal of small flakes, or crushing, from the edge of an artefact.
Effective Coverage	A quantifiable estimate of the area in which archaeological materials are “detectable”, i.e. exposed ground surface area.
Elouera	A type of backed blade, triangular sectioned and resembling an orange segment in shape.
Excavation	An archaeological field method that involves the disturbance of the earth to reveal previously buried archaeological materials.
Exposure	An area of land surface where the ground surface is visible, usually as the result of either thinner vegetation cover, erosive forces or human-caused disturbance. In archaeological surveys, the percentage of ground surface that is visible is recorded. These percentages of exposure are then used to calculate effective coverage.
Feature	An artefact that cannot be normally removed from a site, e.g. foundations.
Flake	Any piece of stone struck off a core. It has a series of characteristics showing that it has been struck off. The most indicative of these features are ring cracks, showing where the hammer hit the core. Also the ventral surface may be deformed in characteristic fashion.
Flaked Piece/Waste Flake	An unmodified and unused flake, usually the by product of tool manufacture or core preparation.

Fluvial	Pertaining to rivers and streams. Deposits by flowing water.
Grinding Groove	A depression formed in rock from the sharpening of a stone hatchet head or use of a muller (topstone).
Grinding Stone	The abrasive stone used to abrade another artefact or to process food.
Ground Edge Hatchet	A stone axe that is oval or round in shape and has edges formed by grinding and sharpening. Ground edge axes were hafted to wooden handles using resin, wax or a combination of material.
Ground Visibility	A term used to describe the area of the ground's surface that is visible during archaeological field surveys.
Hafting	The process of attaching a stone artefact onto a handle or spear.
Hammerstone	A stone that has been used to strike a core to remove a flake, often causing pitting or other wear on the stone's surface.
Hearth	Fireplace often recognised archaeologically through the presence of charcoal or burnt ground. Historical hearths are usually associated with a brick or stone structure.
Heritage	The word 'heritage' is commonly used to refer to our inheritance from the past. Heritage can be used to cover natural environment as well, for example the Natural Heritage Charter. In this document, cultural heritage refers to all Indigenous places and objects, and associated values, traditions, knowledge and cultures.
Holocene	The geological period covering the last 10,000 years.
Indurated Mudstone	Indurated mudstone (sometimes referred to as "tuff") is a general term that encompasses sedimentary rocks from very fine mud-sized particles that are invisible to the naked eye. The term may also encompass siltstones and claystones.
In Situ	In the natural or original position. Applied to a rock, soil, or fossil when occurring in the situation in which it was originally formed or deposited.
***In situ* conservation**	Strategies and initiatives designed for the preservation and conservation of historical archaeological materials without the need to collect or excavate materials from their archaeological context.
Interpretation	A way of communicating meaning and relationships using original artefacts, by first-hand experience and by illustrations.
Isolated Find	A single artefact not located with any other.
Knapping	The process of striking rocks and causing them to fracture.
Landform Element	A small area of the landscape, within an area of 30 m, with particular geomorphic attributes.
Lithics	Of, or pertaining to, stone.
Manuport	An object that is unmodified but has been transported to its location by humans.
Microlith	Small backed stone artefacts.
Midden	A deposit of occupation debris, rubbish, or other by-products of human activity.
Natural Transformation	Change in the archaeological record as a result of natural processes.
Object	See Aboriginal object.
Place	See Aboriginal place.
Pleistocene	The geological period equivalent to the last ice age and preceding the Holocene from about 2 million years to 10,000 years ago. The Late Pleistocene generally refers to the period of time from 40,000 – 10,000 years ago.

Post-depositional	After deposition. A term commonly used with reference to factors affecting the preservation of artefacts and archaeological features.
Potential Archaeological Deposit	An area of the landscape that is believed to contain subsurface archaeological deposit.
Quartz	A hard transparent mineral commonly used in the manufacture of stone artefacts.
Quartzite	A metamorphic siliceous rock commonly used in the manufacture of stone artefacts.
Retouched Flake	A flake that has been flaked again in a manner that modifies an edge, commonly for the purpose of resharpening that edge.
Salvage Excavation	The archaeological excavation of a site conducted to obtain an example of the heritage values entailed within that site.
Scarred Tree	A tree that bears a scar or scars, which are wounds formed from a range of natural, accidental or deliberate impacts that cause damage to living plant tissue on a trunk or limb. See also *Aboriginal Scarred Tree*.
Scraper	A stone tool made on a flake or core with steep retouch along one or more edges.
Seriation	Method used to place artefacts in chronological order. Similar artefacts are placed more closely together.
Settlement Pattern	Distribution of human settlement on the landscape.
Significance	A term typically used to define the level of importance of a heritage site or place.
Silcrete	A siliceous rock commonly used in the manufacture of stone artefacts.
Site	An area where archaeological evidence is observed.
Stone Arrangement	An arrangement of stones into a shape or pattern. Often used for ceremonial purposes or place markers.
Surface Site	A site where artefacts are found on the ground surface.
Survey Coverage	The area of a study area surveyed, usually expressed as a percentage. See also Effective Coverage.
Sustainability	Sustainability is the ability to maintain the qualities that are valued in the built and natural environment. Sustainability can be measured in terms of economic, environmental and social factors.
Test Excavation	Excavation of small sections of an area to determine the archaeological remains and significance.
Toe-Hold	Small scar on the trunk and branches of a tree originally to facilitate climbing.
Tuff	Solidified volcanic ash. Used by some archaeologists to refer to indurated mudstone.
Usewear	The wear displayed on an artefact as a result of its use.

Abbreviations and Acronyms

AFT	Artefact. Used in the AHIMS database to refer to an Aboriginal site feature/s comprising stone artefacts.
ACHMP	Aboriginal Cultural Heritage Management Plan.
AHC	Australian Heritage Council.
AHILA	Aboriginal Heritage Information Licence Agreement. Licence agreement between DECCW and authorised persons to obtain large amounts of data from AHIMS.
AHIMS	Aboriginal Heritage Information Management System. Database of recorded Aboriginal sites across NSW managed by DECCW.
CA	Conservation Area. See glossary of terms.
CHL	Commonwealth Heritage List.
DECCW	Department of Environment, Climate Change and Water.
DEWR	Department of Environment and Water Resources.
DoP	Department of Planning.
GDG	Grinding Groove. Used in the AHIMS database to refer to an Aboriginal site feature/s comprising stone artefacts.
HMZ	Heritage Management Zone. See glossary of terms.
ICOMOS	International Council on Monuments and Sites.
LEP	Local Environmental Plan.
LGA	Local Government Area.
MGA	Map Grid of Australia.
NHL	National Heritage List
NNTT	National Native Title Tribunal.
PAD	Potential Archaeological Deposit.
REF	Review of Environmental Factors.
RNE	Register of the National Estate.
SHI	State Heritage Inventory.
SHR	State Heritage Register.
SHI	Statement of Heritage Impact.
STA	Stone Arrangement. Used in the AHIMS database to refer to an Aboriginal site feature/s comprising stone arrangement/s.
TRE	Scarred/Carved Tree. Used in the AHIMS database to refer to an Aboriginal site feature/s comprising Aboriginal scarred or carved trees.

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Executive Summary

The following is a summary of the findings of this report:

- A review of the Aboriginal Heritage Information Management System (AHIMS) database administered by Department of Environment, Climate Change and Water (DECCW) suggest there are 13 previously recorded Aboriginal sites within the pipeline easement and a 100m wide pipeline buffer zone. Of these sites, six are close enough to the pipeline easement to warrant further investigation;
- a total of 36 Aboriginal sites were identified during the field survey – six isolated finds and 30 low density artefact scatters. Of these sites, 29 are expected to be impacted by the proposal;
- the nature of the construction and the need to keep works within the existing pipeline easement mean that alternative pipeline routes are not possible;
- there are no indications at present that there are significant Aboriginal heritage values that would be affected by the development. Sites which will be impacted have already been subject to substantial disturbance associated with the initial pipeline construction;
- there are no previously heritage-listed historic heritage items within the study area;
- no items of potential historic heritage value were identified during the field survey;
- on the basis of this assessment, it is considered the proposed development will encounter surface and possibly subsurface Aboriginal objects
- on the basis of this assessment, it is considered the proposed development is unlikely to encounter historic heritage relics.

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Eastern Australian Pipeline Pty Ltd, a wholly owned subsidiary of APA Group Pty Ltd (APA) to prepare an Environmental Assessment (EA) for the construction of natural gas pipeline between Young and Wagga Wagga (**Figure F1**). The pipeline project was divided into two stages (**Figure F2**):

- Stage 1: Wagga Wagga to Bethungra; and
- Stage 2: Bethungra to Young.

An assessment of Aboriginal and historic heritage was conducted to inform the EA. This report provides the results of the Aboriginal and historic heritage assessment for Stage 1 of the pipeline project from Wagga Wagga to Bethungra. The assessment of the Stage 2 area will be conducted at a later date and the results presented in a separate report.

The heritage assessment involved the survey and inspection of lands directly impacted by the project, that is, lands within the existing 20 m-wide pipeline easement. Lands outside the pipeline easement were generally not assessed, except along major creeklines where both banks were surveyed to a distance of 100 m either side of the pipeline easement.

Relevant legislation, summarised further in **Section 9.0** is the *Environmental Planning and Assessment Act 1979*, *Heritage Act 1977* and the *National Parks and Wildlife Act 1974*. Relevant guidelines include the *Aboriginal Cultural Heritage: Standards & Guidelines Kit* (NPWS 1997), draft *Part 3A EP&A Act Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC/DoP 2007), the *Heritage Manual* (NSW Heritage Office) and the *Burra Charter* (Australia ICOMOS 1999). The Aboriginal consultation process for this project followed the Department of Environment, Climate Change and Water's (DECCW) *Interim Community Consultation Requirements for Applicants* (DEC 2004).

1.1 Project Background

APA Group Pty Ltd (APA), a subsidiary of Agility Management Pty Ltd, are proposing to construct a new 18-inch pressure gas transmission pipeline between Young and Wagga Wagga in western NSW. The new gas pipeline will loop the existing 12-inch pipeline to provide additional gas storage capacity. The project involves construction of a gas pipeline over a distance of approximately 131 km between Young and Wagga Wagga. The pipeline will be buried, and will involve approximately 49 creek and/or ephemeral drainage line crossings using either open cut trenching, directional-drilling or thrust-boring.

The existing 12-inch pipe was constructed in 1980 and an Aboriginal heritage assessment (Witter 1980) was conducted prior to the works commencing (**Section 2.3**). Several Aboriginal sites were identified at that time, many of which were impacted by construction of the pipeline.

Director General's Requirements (DGRs) have been issued for the project and, for the heritage assessment, require sufficient information to demonstrate

- the likely impacts to Aboriginal heritage values/items;
- an outline of proposed mitigation measures;
- effective consultation with Aboriginal communities; and
- any impacts to non-indigenous heritage sites should they occur along the pipeline route.

This report provides the results of the heritage assessment component of Stage 1 of the EA.

1.2 Aims

The overall aim of this assessment was to identify the Aboriginal and historic heritage values of the project land, identify potential development impacts on those values and provide suitable management commitments. To achieve these aims the following objectives were established:

- to consult with the relevant local Aboriginal community groups regarding the specific social value of land in the study area;

- to understand the regional research context of any Aboriginal sites or objects, and any historic sites or items, in the study area.
- to identify documented Aboriginal heritage sites/objects and/or historic heritage sites within the study area;
- to identify and record any undocumented Aboriginal sites and objects, and any historic sites or items within the study area;
- to assess the cultural significance of Aboriginal sites and objects in the study area in consultation with the Aboriginal stakeholders;
- to assess the cultural significance of historic heritage sites and items in the study area; and
- to prepare recommendations and commitments on the management of Aboriginal and historic heritage values within the study area, when compared with the proposed development footprint.

1.3 Study Area

The overall study area for the pipeline construction project consists of an existing 20 m wide gas pipeline easement commencing at the Young Control Station and terminating at the Bomen Meter Station, north east of Wagga Wagga. The easement has been extensively disturbed by the construction of an existing 12 inch pipeline in 1980 and, in part, by the construction of an optical fibre cable in 2006. The study area covered by this report (Stage 1) includes the 20 m-wide easement between the Bomen Meter Station and a point approximately 8 km north east of Bethungra, and is hereafter referred to as the study area. The total length of Stage 1 of the pipeline is 61km.

The easement traverses mainly private landholdings, the majority of which have been cleared of native vegetation and are either under pasture or crops.

1.4 Project Team

The Project Team consists of archaeologists and other specialists from AECOM, and representatives of the local Aboriginal community. Rick Bullers (AECOM Professional Archaeologist) managed the project, conducted the fieldwork and co-wrote this report. Peter Howard (AECOM Archaeologist assisted with field survey and co-wrote the report. Neville Baker (AECOM Associate Director Archaeologist) provided technical and QA review of this report. Lee-Anne Bishop and Tim Osborne provided administrative and drafting support. Prakash Mehta, Manager Projects NSW, was the client’s representative.

1.5 Report Structure

The report structure relates to the sections of the report and their contribution to the study.

- **Section 2.0** provides environmental and archaeological contextual information;
- **Section 3.0** describes the assessment methodology employed;
- **Section 4.0** describes the methodology and results of consultation with the Aboriginal community;
- **Section 5.0** lists the Aboriginal sites and objects and historic heritage sites and items identified in the study area, and discusses the results of the field survey;
- **Section 6.0** discusses the Historic heritage values within the study area;
- **Section 7.0** discusses the Aboriginal heritage values within the study area;
- **Section 8.0** discusses the potential impacts associated with the development on both historic and Aboriginal sites;
- **Section 9.0** describes legislation guiding Aboriginal and historic heritage management; and
- **Section 10.0** describes the heritage mitigation measures which will be used for the project
- **Section 11.0** provides succinct management recommendations regarding the Aboriginal and historic heritage values of the study area.

1.6 Limitations

Predictions have been made about the probability of subsurface archaeological materials occurring within the study area. It is possible that materials may occur in any landscape context, and the assessment of subsurface materials refers to the likelihood of occurrence based on surface indications and environmental context.

AECOM has undertaken a search of the Aboriginal Heritage Information Management System (AHIMS) held by DECCW. The search results are provided in **Appendix A**. Register searches are constrained by the amount of data in the register and the quality of that data (for example grid references can be inaccurate). Large areas of NSW may not have been systematically searched and may contain Aboriginal objects and other heritage values not recorded on AHIMS.

Additionally, the AHIMS reports database can only be searched by the title of the report, which may not indicate the geographical location of the area covered. This means that it is possible that some known sites and some reports may have been omitted from this study. Sites and reports are regularly added and removed from AHIMS and therefore the accuracy of information provided from AHIMS is only valid on the day the register is searched.

A summary of the statutory requirements regarding Aboriginal and historic heritage is provided in Section 9.0 This is provided based on experience with the heritage system in NSW and does not purport to be legal advice. It should be noted that legislation, regulations and guidelines change over time, and users of the report should satisfy themselves that the statutory requirements have not changed since the report was written.

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2.0 Existing Environment

Investigations of the distribution of archaeological objects and places include an analysis of information on the natural resources available in a region to gain an understanding of the range of cultural remains that can be expected. For example, ecological and hydrological resources can give an insight into the range of available life-support resources available to Aboriginal hunter-gatherers in antiquity. Geological resources may constrain the types of Aboriginal site that can be expected and soil types may inform an assessment of the current physical context of an Aboriginal site.

Water availability is a major influence on the intensity of Aboriginal occupation and evidence, usually in the form of flaked stone artefacts, is often associated with permanent or semi-permanent water sources.

Soil types are influential as accumulating sediments can cover cultural remains while areas of sediment removal through erosion can either uncover buried archaeological material or transport small items away from the original depositional context. Soil analysis has important ramifications for archaeological research through the potential impact of different soils on human activity (such as agricultural exploitation) and the impact of the soils on archaeological evidence (such as post-depositional movement). The soils known to occur throughout the study area are identified here in order to delineate their nature and impact on the survival and location of archaeological material.

A detailed description of archaeological evidence is also presented below to further analyse and interpret the spatial distribution and likelihood of archaeological material occurring within the study area.

Information on the geology, soil landscapes and topography in the region is presented below. This data was used in the analysis of archaeological potential for the study area and subsequent heritage constraints map.

2.1.1 Climate

There are four distinct seasons in the South West Slopes and Plains with cool to cold winters and warm summers. Maximum average temperatures in summer range between 29°C at Cootamundra and 33°C at Wagga Wagga and the relative humidity is low with an average of approximately 30%. The average overnight minimum temperature in winter ranges from 1.4°C at Young and 3.3°C at Wagga Wagga. The daily maximum in winter ranges between 12°C and 14°C. Frost and fog are common in winter and on rare occasions, snow has been recorded. The relative humidity in winter averages over 60% at 3 pm and approximately 90% at 9 pm (Bureau of Meteorology 2009).

2.1.2 Topography and Hydrology

The study area is generally gently undulating with an elevation ranging between about 210-310 m. The study area is characterised by a series of low ridges and hilltops, generally oriented NW-SE interspersed with numerous drainage lines ranging from first-order drainage depressions to entrenched fourth-order ephemeral creeks. Major creeks in the study area include Reedy Creek and Bucks Creek, both fourth-order creeks crossing the study area near Harefield, Wanitool Creek (second-order) south east of Junee, Billabung Creek (two fourth-order branches) south west of Bethungra, and Ullandra Creek, north of Bethungra (**Plate P1**, **Plate P2** and **Plate P3**).

Most first-order drainage lines lie on gently undulating terrain with no defined channel or banks, and often form part of a continuous agricultural landscape (i.e. crops or pasture cover the drainage line) (**Plate P4**). Often the presence of dams are the only indication that there is any water flow at all. Higher order streams (third-order or higher, and occasional second-order) may have a defined channel, the higher the stream order, the larger and/or deeper the channel. Most watercourses in the study area flow in a north westerly direction approximately perpendicular to the study area. All named creeks in the study area have existing AHIMS-registered Aboriginal sites.

The Wagga Wagga catchment area comprises heavy clay soils, with only a small catchment discharge point. The combination of geographical and geological features prevents groundwater from easily migrating away from the area, resulting in waterlogging and increased salinity, affecting both urban and agricultural environments (Wagga Wagga City Council 2007).

2.1.3 Geology and Soils

The geology underlying the site is dominated by Silurian granites, predominantly Wantabadgery Granodiorite and Collingullie Granite, with small parts of Burrandana Granite. Thick clay sequences are present, with significant aeolian clay additions deposited on sideslopes and in drainage depressions.

There are three regional hydrogeological units of the Wagga Wagga area, including the Ordovician meta-sediments, the Silurian granites and Tertiary and Quaternary alluvium (CSIRO 2001).

The Soil Landscapes of the Wagga Wagga 1:100,000 Sheet (Chen and McKane 1996) indicates that the southern extent of the pipeline route is situated in an area characteristic of the East Bomen soil landscape. This area is characterised by undulating rises of Silurian Wantabadgery Granodiorite with a local relief of between 15-40 m consisting of broad crests and ridges and shallow drainage depressions. Slope gradients range between 3-10%. The East Bomen soil landscape is derived from Aeolian deposits and is dominated by shallow to moderately deep (40-200 cm) loam and clay soils. These soils have a moderate erosion hazard. The shallow nature of this soil landscape results in limitations and difficulties for excavation and urban development, slight to moderate limitations for cultivation and low limitations for grazing.

2.1.4 Vegetation

The study area has undergone almost complete clearance of native vegetation for agricultural and/or pastoral purposes. Vegetation observed by AECOM personnel included various pasture grasses and weeds, including some areas characterised by thick wheat grasses (*Triticum* sp.) (**Plate P5**). Remnant native vegetation was restricted mainly to the banks of larger creeks such as Bucks, Billabung and Ullandra Creeks, and as sporadic isolated and small stands of trees in pasture paddocks (**Plate P6**). Very few instances of older growth mature trees were observed, with the majority being younger regrowth. Large areas of the study area were under cereal crops such as wheat (**Plate P7**).

2.1.5 Disturbance

The general area in which the study area lays has been subject to minor disturbance resulting from agricultural/pastoral use of the landscape. Native vegetation has been largely cleared throughout the entire length of the easement, although some remnant stands of mature canopy growth still remains within the easement, particularly at the north eastern end of the study area towards Bethungra. Pastoral and/or cropping often leaves archaeological deposits intact (see below).

However, it is the construction of the existing 12-inch gas pipeline in 1980 and the optical fibre cable laying in 2006 that has created the greatest disturbance to the study area. Construction of pipelines often involves completely stripping topsoils in the path of the pipeline to a width of 20 m-plus, which would affect any surface archaeological materials and/or shallow subsurface deposits (**Plate P8**). Excavation of the trench in which the pipeline is laid will disturb and largely remove any archaeological deposits. In addition, construction of ancillary infrastructure (e.g. line valves and meter stations) will disturb subsurface deposits to a much greater width than the pipeline trench, and construction lay down areas will also disturb surface and shallow archaeological deposits.

The exception to this is where directional-drilling is used to pass under either roads or substantial water courses. Depending on the depth of the creek channel, entry and exit points for the under-bored pipeline may be far enough removed from the creek banks to minimise disturbance to archaeological deposits, which are associated with those water courses.

2.1.6 Summary of Environmental Conditions

While the climatic records indicate that the general vicinity of Wagga Wagga provided numerous resources for Aboriginal people in the past, most notably water from the Snowy Mountains, the specific location of the study area is unlikely to be particularly conducive to settlement or use based on the information above. It seems likely that Aboriginal people would have predominantly utilised and settled adjacent both main creek lines, and more often, smaller adjoining tributaries nearby. The study area runs across gently undulating plain and crosses many drainage lines and some more substantial creeks, but none of these waterways hold permanent water. While there are several dams in and near the study area, these are often completely artificial and do not relate to any form of historic waterway.

The removal of the vegetation and modification of the soils through agricultural activities also reduces the potential for any archaeological remains to survive. The undulating slopes of the study area further permit erosion and removal of the soil profile where farming has not completely intermixed it with the subsoils below. Based on aerial photographs, the potential for scarred/carved trees is also low due to the historic removal of most of the trees in this area.

The geology of the study area retains both quartz and quartzite, both of which are raw materials for artefact production. However, these raw materials are also located across much of this region, and therefore do not highlight this area as of particular importance in relation to these materials.

2.2 Ethno-Historical and Historical Context

This section provides background on the lifestyles of both Aboriginal people and European settlers to provide context for identifying archaeological and heritage sites within the present-day material record. Much of the following discussion of Aboriginal lifeways and post-European settlement history was extracted from HO and DUAP (1996, cited in DECCW 2009), except where otherwise stated.

2.2.1 Aboriginal Occupation

The study area is located within the South West Slopes region of New South Wales, which was traditionally occupied by people of the Wiradjuri language group[1] prior to European Settlement. This language group covered a large proportion of central NSW, covering an area of some 97,100 square kilometres. According to Tindale (1974: map supplements), the area occupied by the Wiradjuri extended from north of Dubbo an Mudgee in the north east, via Parkes and Condoblin, west to near Hay, south to Albury on the Murray River and east to about Gundagai, Bathurst and Tumbarumba.

Tindale (1974: 201) lists the Wiradjuri as one of the largest language groupings in Australia, with many hordes. Howitt (1884) identifies the Kutamundra hoard (named for the kutamun turtle). Although the Wiradjuri were of one language group, there were differences in dialect, notably at Bathurst and Albury. Tribal coherence was assisted by a cycle of ceremonies that moved in a ring around the whole tribal area.

Wiradjuri country straddled three of NSW inland rivers, the Macquarie, Lachlan and Murrumbidgee Rivers; the name Wiradjuri means “people of the three rivers”. For the Wiradjuri people, the three rivers provided their livelihood and supplied a variety of consistent and abundant food provisions including shellfish and fish such as Murray cod. In dry seasons the food from the rivers was supplemented with kangaroos and emus hunted for their meat, as well as fresh food gathered from the land between the rivers, including fruit, nuts, yam daisies, wattle seeds and orchid tubers.

Evidence of the presence of the Wiradjuri people is common along the Macquarie and Lachlan Rivers, but less so along the Murrumbidgee in the south, even though the Wiradjuri people lived on both sides of the Murrumbidgee. Surviving carved trees are numerous in the northern part of the traditional Wiradjuri range, whereas there are only three of these surviving near the Murrumbidgee. The reason for this is not clear, although the original presence of such carved trees is not necessarily indicated by their present-day distribution (HO and DUAP, cited in DECCW 2009).

The Wiradjuri people generally moved around in small groups, using the river flats, open land and waterways with some regularity through the seasons as indicated by debris that has accumulated in these areas. The Wiradjuri people travelled to the alpine regions of the South Eastern Highlands and Australian Alps regions for the annual summer feasts of bogong moths.

Between 4000 – 1500 BP, an estimated 2000-3000 Aboriginal people were living in the semi-permanent camps throughout the Wagga Wagga LGA. The impacts of European settlement were first apparent amongst the Wiradjuri in the 1790s when small pox was inadvertently introduced by Eora traders, devastating the population. Contact gradually increased as European settlers arrived in the area. Conflict and the negative attitudes of some settlers resulted in a great reduction of the Wiradjuri population to less than 20 by 1900 (Go Green Services, 2002).

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[1] Wiradjuri is also known in the various literature as Wiradyuri, Wiradhuri, Wiraduri, Wiradjeri, Wirrajerre, Wiradhari, Wirra-dhari, Wirradhurri, Wirraijuri, Wirrathuri, Wiradthuri, Wiradtheri, Wirathere, Wira-durei, Wira-shurri, Wirradgerry, Woradjeri, Wooradjeri, Woorajuri, Woradjerg, Wirotheree, Wiratheri, Wi-ra jer-ree, Wirrai Durhai or Wagga tribe (a group) (AusAnthrop 2009).

Plate 1: Wiradjuri ceremonial gathering at Wellington c. 1847, by William Curtis

State Library of NSW, ML1374

Following European settlement in the region, the Wiradjuri were hard-hit by Australia's second smallpox epidemic in 1830. Approximately one in three Wiradjuri died from the disease, although vaccination halted total decimation (Flood 2006: 102).

Clashes between the settlers and the local Aboriginal people were common around the Murrumbidgee, particularly between 1839 and 1841. These violent incidents have been termed the "Wiradjuri wars". Wiradjuri people responded to the killing of their people, and the loss of their fishing grounds and significant sites, by stealing cattle and spearing stockmen.

The settlers' concerns about the dangers of the Aboriginal people subsided during the 1840s as did the independence of the Wiradjuri people. By the 1850s, although corroborees were still being held on the hills surrounding Mudgee, the culture of the local Aborigines had been vitiated by disease, alcohol and mass European influx during gold rush periods.

Today, the Wiradjuri people maintain a strong cultural identity, with a high degree of marriage within the Wiradjuri community contributing to this strength of identity (DECCW 2009). The major Wiradjuri groups currently live in Condobolin, Peak Hill, Narrandera and Griffith, with significant populations at Wagga Wagga and Leeton and smaller groups at West Wyalong, Parkes, Forbes, Cootamundra and Young.

2.2.2 European Settlement

Explorers Charles Sturt and George Macleay were among the first Europeans to travel through the South West Slopes. Sturt's second expedition, taking place in 1829-30, traced the Murrumbidgee River to its junction with the Murray River and on to the mouth of the Murray at Lake Alexandrina. The area was reported to have good pasture, particularly along the floodplains of the Murrumbidgee River. Reports also suggested that Aboriginal occupation was sparse (Navin Officer 2002).

Within 15 years pastoralists occupied most of the river frontages on the Murrumbidgee River. John Oxley had explored the region to the north in 1817 and soon after pastoralists began to bring their cattle to the region. By the 1820s, pastoralists were already making their mark on the landscape. On the southern bank of the Murrumbidgee, Peter Stuckey had introduced willows that grew along the river in competition with the native casuarinas and eucalypts.

Stock were already grazing in the southeast of the region in 1826 and settlement extended west along the Murrumbidgee, with emancipists such as Charles Tompson and George Best settling near what is now Wagga Wagga. As Murrumbidgee frontages were occupied, settlement began to spread to the river tributaries, expanding north and south from the Murrumbidgee.

The traditional lands and lifestyles of the Wiradjuri people were steadily overtaken by Europeans. To the north around Mudgee and Rylstone, large pastoral properties developed, eventually becoming towns in 1837 and 1842 respectively. Cattle runs were established in Narrandera in 1832 and these were followed from 1840 by sheep stations (NPWS 1991) such as Buckingbong Station which was well watered by nearby swamps and creeks even in the drought years. Wheat was grown in the area for use on the stations. Albury began as a sheep station in 1835 on both sides of the Murray River and merged soon after with the nearby Wodonga Run on what is now the Victorian side of the river (NPWS 1991).

Township Development

Townships in the general vicinity of the pipeline route were largely founded as the result of settlement of early pastoral runs, or to service the railway between Albury and Goulburn, or as the result of gold rushes that occurred in the mid- to late-1800s.

The village of Wagga Wagga was established in 1847. Although the early settlements were illegal as they were outside the limits of settlement, settlers took up the lands surrounding Wagga Wagga for pastoral activities (Navin Officer 2002). The so-called 'Wiradjuri wars' led to the temporary departure of pastoralists from some runs in the area around 1839-40, so fearful were they of resistance by the local Aborigines determined to keep their land. However, most station owners returned later in the 1840s and sheep and cattle numbers grew.

A severe drought hit the Murrumbidgee area in 1850-51 just as the gold rushes began. As the drought yielded and the population of the area increased with the gold rush, meat prices soared and cattle and sheep farmers benefited. Production of beef, which had been increased to cope with demand during the gold rush, slumped in the decades following, while sheep numbers increased five-fold around the Murrumbidgee and LacAECOMn Rivers up to the 1870s. Increased stock numbers led to further occupation of land. To accommodate this ongoing development, pastoralists cleared what was left of the uncleared land in the area, sinking wells, building dams and fencing the land as they went.

Gundagai was among the first towns to be settled in the area, developing in the early 1840s around the Gundagai Run that was established in 1826. By the 1850s Gundagai was the principal town in the south of the region but was eventually overshadowed by Wagga Wagga after the main road south from Dubbo to Albury by-passed Gundagai, passing through Wagga instead which had grown considerably, almost doubling in population in the late 1850s. Wagga's importance was also increased by a brief steamboat venture, increasing river traffic through the town in the 1870s.

Cootamundra was first settled in the 1830s, originally a stock station called "Cootamondra" owned by pioneer John Hurley. By the 1860s settlement around the station had increased to such an extent that a certain amount of town planning was necessary. The town was surveyed as the "village of Cootamundry" and the plan was approved in 1861. The railway came through in 1877 encouraging the further growth of pastoral and related industries including beef, lamb, wool and grain crops (CSC 2009).

Junee was first settled in the 1840s when Leopold de Salis, pastoralist and later politician, established the 'Jewnee' pastoral run. After a post office opened there in 1862, the village of 'Jewnee' was gazetted in 1863 on the wool road to Sydney. Jewnee became established as a major link in the Goulburn to Albury railway, after the construction of railway repair facilities. The railway had passed 8 km east of the town but, in 1881, the town was relocated to the railway line and re-named Junee in 1893. The original site of Juwnee became Old Junee.

Following the gold rush, the advent of rail transport provided the impetus for a second economic boom that provided local agricultural producers with very affordable direct access to both markets. In 1952 the largest wheat terminal in the Southern Hemisphere was built at Junee

The Gold Rush

New towns were established and existing small villages experienced major population increases with the discovery of gold during the mid 1800s. Gold rushes occurred in Adelong (1852, expanding from 1857), Young (1860), Junee (1860s), Temora (1869) and Albury (1880s).

The Young area had been settled prior to 1842 when James White and his family founded Burrangong Station at Lambing Flat. White was apparently notable for his settlement of the area in harmony with the local Aboriginal people. The early years of settlement saw agricultural pursuits carried out but these quickly gave way in the mid-1800s to the mining of gold and Lambing Flat soon became renowned for its rich goldfields. With a huge influx of miners a shanty type town soon sprung up (YSC 2009).

Plate 2: Mine workings at Temora, date unknown

State Library of NSW, Image No. bcp_02936

The lure of gold attracted diggers from far and wide, including many Chinese miners. The area was rich in gold and the mining population mushroomed from 1,500 to 10,000 within six months. The Chinese miners were confined to a small area to mine and were the target of brutal rioting later in 1860 (**Plate 3**). As a result, the NSW *Chinese Immigration Restriction Act* was passed later that year. The miners who had caused the riots against the Chinese then moved further north to mine at Forbes to the north.

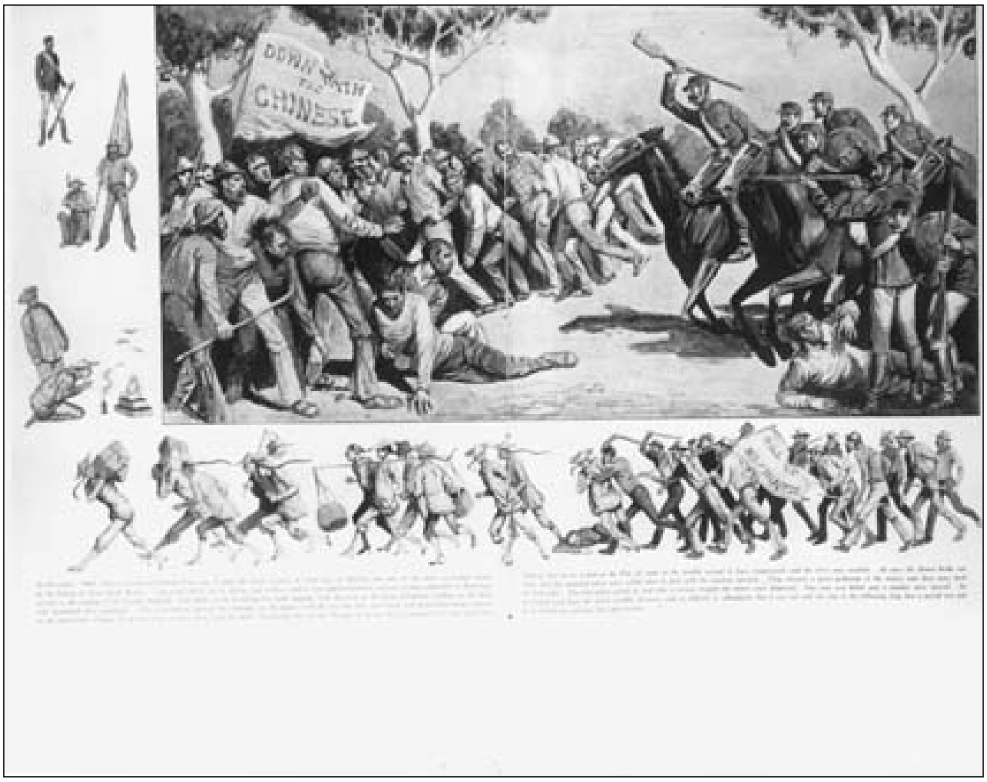

Plate 3: Chinese Workers in Lambing Flat Riots, December 1860

National Archives of Australia, Image No. A12111, 2/1918/20A/2

In 1866 Junee's population was recorded as 12 but the discovery of reef and alluvial gold during the 1860s triggered a gold rush. The main sites - Old Junee (to the west), Junee Reefs (to the north) and Illabo (to the north-east) - were mined until the 1880s (SMH 2009).

Before the advent of the Murrumbidgee Irrigation Area at the turn of the century, fruit growing, especially cherries, was a successful enterprise around Young. Although cherries were planted in the region as early as 1847, the first commercial orchards were not a reality until they were planted by Nicole Jasprizza in 1878. Over time, more than 70 cherry orchards were established, and the market was more accessible when the railway reached Young in 1885. By 1933, Jasprizza was believed to have the largest cherry orchard in the world. Apples, grapes, pears, prunes, quinces, oranges and strawberries were also grown in the area, with Young apples rivalling cherries as the most lucrative crop.

Agriculture in the south of the region made great improvements following the success of an experimental farm established near Wagga Wagga Wagga in 1892 by the state government. The farm tested strains of wheat and gave advice to farmers while encouraging the planting of new crops including maize, potatoes, grapes and other fruit. A series of dams and other water conservation innovations led to the inception of the Murrumbidgee Irrigation Area in the early 1900s.

2.3 Archaeological Context

The archaeological context section outlines the known Aboriginal sites in the region and provides a review of previous studies undertaken in the area. This section will provide a synthesis, which was used in subsequent site prediction methods.

2.3.1 Review of Previous Archaeological Studies

A review of previous archaeological studies conducted in the region provides a basis for determining the types and extent of archaeological resources that may be impacted by the proposal. While the number of surveys have been relatively limited, and constrained to areas that have been the subject of development, the information is useful in identifying a regional pattern of site location that guides predictive modelling of site types and likely location in the area of this development.

Of most relevance to this development are the archaeological surveys carried out on the route of the existing 12-inch natural gas pipeline (Willliams Brothers-CMPS Engineers 1975; Pipeline Authority n.d.; Witter 1980). Neither the Environmental Impact statement (EIS) for the Western Lateral natural gas pipeline (Williams Brothers-CMPS Engineers 1975: 24) or for the Cootamundra to Wagga Wagga section of the pipeline (Pipeline Authority n.d.: 13), which briefly described searches on creek and river crossings along the route, identified any known historic or Aboriginal sites. However the latter EIS advised that further searches would be carried out by National Parks and Wildlife Service (NPWS).

A subsequent survey of the gas pipeline route (Witter 1980) identified a total of 14 open camp sites (stone artefacts scatters), 21 isolated finds (single stone artefacts), a scarred tree and a possible Aboriginal rock well. Sites identified by Witter almost always occurred in association with creeks or small ephemeral water courses, but in a range of landform contexts including alluvial flats, low ridges and gentle slopes. Sites most frequently occurred on slopes and spurs associated with those water courses.

Witter (1980) recommended excavation of some of these sites if they could not be avoided. One site (AHIMS #50-5-0009) was subsequently excavated and partially salvaged (Kelly 1980). This site, was originally described by Witter (1980) as an artefact scatter measuring some 850 m along the southern bank of Bucks Creek, and was typical of the sites recorded along the pipeline route. Kelly (1980) collected all surface artefacts in Zone A irrespective of whether they were in the pipeline easement or not. A total of 310 stone artefacts were collected from Zone A, most of which (90%) were quartz and less than 30 mm in length. Formal artefact types were uncommon, with debitage or waste material forming the highest percentage of the assemblage.

In addition to Witter's (1980) pipeline survey, several surveys have been conducted in the Junee area including Packard and Hughes (1983), Bonhomme (1986, 1987), Stone (1986) and Nicholson (1990). Nicholson (1990) conducted as assessment of the route of a natural gas pipeline feeding to Junee from the existing Young to Wagga Wagga gas pipeline. The six kilometere route followed similar terrain to the terrain in parts of the current study area. Nicholson (1990: 5) did not identify any new Aboriginal sites and concluded that:

> *The type of landscape through which the pipeline runs is not likely to contain archaeological sites. Sites in this area have been found to be located on rises adjacent to water courses rather than on undulating country away from water sources such as that through which the proposed pipeline will pass. The absence of archaeological sites along the pipeline route is therefore not unexpected.*

This premise may be generally correct, but Witter (1980), and subsequently Kelton (2006) adding information to the same site, found evidence of Aboriginal occupation in an ephemeral drainage line 1 km south of Nicholson's study area. This site consisted of possible water holes and a quartz fragment scatter. The nearest reliable water source is Wantiool Creek some 2 km north (and north of Nicholson's study area). This shows that evidence of occupation may not necessarily be restricted to the vicinity of major water courses. On the contrary, Witter's land-use model (see **Section 2.3.3**) suggests that in times of good rainfall, the headwaters of drainage lines become a more viable area of occupation. However, it is also likely that any evidence of occupation in these landforms are likely to be of a minor nature such as very low density stone artefact scatters or isolated finds.

Bonhomme (1987) conducted a similar natural gas pipeline survey to the north of Junee and recorded a total of 18 sites including seven artefact scatters, eight isolated finds and three scarred trees. Six of the seven artefact scatters were located on hill slopes within 100 m of a permanent or semi-permanent watercourse, with the majority within 50 m. Only one site was recorded away from a water course.

Witter and Hughes (1983) conducted a survey of the routes of proposed transmission lines in the Murrumburrah area. They identified two major 'land systems' in this area:

1) Plateau; and
2) Major stream valleys

During the survey they recorded a total of 18 Aboriginal sites, including four open camp sites (artefact scatters), 13 isolated finds and one scarred tree. They concluded that the low number of open camp sites found was probably due to the poor ground surface visibility and that there was likely to be more sites that were undetected. However, they maintain that the ratio of sites found in the stream valleys to those found on the plateau were likely to remain consistent, that is 2:1. In other words, Aboriginal site patterning in the region is dominated by site clustering in the valleys of water courses with the open, undulating plateau containing a much lower density of sites. They also concluded that their study area falls within a quartz belt where a specialised quartz technology for stone tools is to be expected, although there was insufficient material to be able to clearly identify different aspects of the quartz industry. They suggest that the presence of unusual quartz cores may indicate the presence of a culturally distinctive zone.

Near Bethungra, an archaeological survey by Paton and Hughes (1985) of the Ullandra Nature Reserve, 6 km south east of the pipeline, identified seven open camp sites and 15 isolated finds, as well as another two isolated finds that had previously been removed by NPWS officers. The stone artefact scatters ranged in artefact numbers from as few as nine artefacts to as many as 67. All sites occurred on low rises associated with creeklines. Two sites were located 100 m from a creek, one was located 70 m from a creek and the remaining four sites were all around 30 m from a creek. Paton and Hughes classed sites with two artefacts as isolated finds. The reserve was divided into four environmental zones and the results of the survey showed that terrain with wide valleys and low relief (Zone 3) held the highest level of archaeological significance. Raw material used included quartz (the majority), silcrete and single occurrences of basalt and quartzite. The environmental zones identified in this study are relevant to parts of the pipeline corridor in the Bethungra area.

Ullandra nature reserve has also been the subject of other archaeological surveys, notably in association with the development and/or upgrade of transmission line infrastructure. Dearling and Grinbergs (2002) conducted a preliminary survey along the TransGrid access tracks and identified 28 Aboriginal sites, as well as another outside their study area on neighbouring private property. A subsequent survey (Dearling 2004) identified a total of 146 stone artefacts within seven artefact scatters and three isolated finds. All 10 sites were located on low gradient spurs or locally elevated locations and most were associated with water courses. One site contained 105 artefacts, 72% of the entire assemblage recorded during the survey.

Kelton (1995a) conducted a survey of the optic fibre cable rout between Cootamundra and Bethungra and found one open camp site on the eastern bank of Ironbong Creek (an extension of Billabong Creek). The site covered some 70 x 40 m and consisted of an estimated 50 stone artefacts including quartz debitage (the majority), flaked pieces and small numbers of cores, scrapers, backed blades and manuport material. A survey of the optic fibre cable route between Bethunra and Illabo (Kelton 1995b) failed to identify any Aboriginal sites despite passing through two areas of Aboriginal ‘sensitivity’.

A survey of several proposed optic fibre cable routes in the area north west of Young (Hamm 1994) identified a total of three Aboriginal sites including an artefact scatter, an isolated find and a scarred tree. In comparison to the stone artefacts in Witter’s (1980) survey, the stone artefacts Hamm found were formed almost exclusively from mudstone and silcrete, with only minor occurrences of quartz in the assemblage. Both the artefact scatter and scarred tree for located on flat alluvial creek floodplains.

Silcox (1987) conducted test excavations at two sites on Cunningham Creek near Murrumburrah, to the south of Young and the current study area. A total of 95 artefacts were recorded from limited excavations undertaken at site JK2. The artefacts occurred at low density averaging 7 artefacts/m^2. The artefacts at JK2 consisted predominantly of small (1-3 cm) quartz pieces, with a high incidence of bipolar artefacts on quartz, and a lack of backed pieces. On the basis of previous studies Silcox (1987: 21) has dated these to the late Holocene period.

A similar assemblage and time period was recorded at site JK1 where 60 artefacts were recorded from two surface sites. The generally high proportion of quartz artefacts compared to other raw materials, was found to be consistent with other surveys and excavations in the general region of the study area (except for Hamm’s (1994) findings to the north east of the study area). Further east, between Goulburn and Yass, silcrete raw material was found to become more predominant and quartz less so. Silcox (1987: 21-22) speculated that this may be the result of either variations in available raw material sources or the result of the use of different technologies.

2.3.2 Local Context

A search for previously recorded Aboriginal sites within the Department of Environment, Climate Change and Water’s (DECCW) Aboriginal Heritage Information Management System (AHIMS) database, was conducted on 2 September 2009. The AHIMS search was conducted for the *entire* pipeline route from Young to Wagga Wagga and identified 27 registered Aboriginal sites within the 331 km^2 search area of the pipeline corridor. The search area included a 1 km wide buffer zone of 500 m either side of the pipeline route).

Within the current study area (Stage 1), 20 sites are located either within the 1 km wide buffer zone (**Table 1**). A careful review of the sites identified in the buffer zone (**Table 2**) shows that although 20 individual sites are recorded, two (AHIMS # 50-5-0078 and 50-5-0083) are subsequent additions to previously recorded sites (AHIMS # 50-5-0004 and 50-5-0003 respectively). For all intents and purposes, these are the same sites, giving a total of 18 recorded sites in the study area.

These sites were plotted onto a map of the study area (**Figure F3**), revealing that out of the 20 registered sites, there were 13 sites of interest within a 100 m wide buffer corridor of the pipeline (i.e. potentially within the path of the proposed construction), and were re-inspected during the current survey. Seven sites were not investigated because they were not within the pipeline easement and of a sufficient distance from the easement to indicate they would not be affected by the proposal.

Table 1: Summary of AHIMS Registered Sites within the Search Area

Site Type*	Number of Sites
Isolated Find	2
Open Camp Site	14
Scarred Tree	1
Stone Quarry	1
Water Hole	1
Water Hole; Open Camp Site	1
Total	**20**

* The search was conducted through the DECCW GIS system within a shapefile of a 1km buffer along the pipeline. Such searches, although obtaining AHIMS data, do not provide site types for individual sites. The site types shown here are based on the information provided on individual site cards. Where a site card does not explicitly state the site type, it was determined by AECOM from the site features described on the site card. Therefore in a few cases, the site type shown here may not mach exactly the site type shown in AHIMS.

The results of the AHIMS search show that open camp sites, consisting of either artefact scatters or isolated finds (stone tool artefacts) are, by far, the most common site type currently known within the study area, accounting for 16 (80%) of recorded sites. The AHIMS results also show that there is one scarred tree, two water hole sites and a stone quarry site (a source of raw material for manufacturing stone tools).

All previously recorded sites that occur within the pipeline easement have been heavily disturbed by both the 1980 pipeline construction and/or the later 2006 optical fibre cable installation. However inspection of the sites indicated that there was still artefactual evidence remaining within the easement at these locations (refer **Section 5.0** for further information).

2.3.3 Land-Use and Occupation Model

A land-use model was developed by Witter (1980a, b, cited in Witter and Hughes 1983) which proposed a number of stages of land use for the western slopes of the Dividing Range depending on the timing, intensity and duration of rainfall.

The drainage pattern is essentially dendritic, with water courses crossing the slopes of the Dividing Range joining to form larger water courses flowing across the plains to the west. Most of the headwater streams are ephemeral and only the larger trunk water courses contain permanent or semi-permanent water.

Witter's model suggests that occupation was economically oriented toward the major stream valleys with perhaps occasional forays into the drier uplands. Movement over the area was triggered by rainfall events. Consequently during dry periods, occupation was confined to the major water course valleys, whilst in wetter periods Aboriginal people were able to move along the temporarily watered headwaters of minor water courses and onto the plateau areas. When conditions became dry again, people retreated back to the wetter valleys. Witter suggests that in times of extreme drought, people may have retreated downstream as far as the Murrumbidgee and Lachlan Rivers.

The archaeological work conducted in the region to date indicates that occupation sites were certainly more frequent in higher-order water course valleys. As Witter and Hughes (1983: 12) suggest, the archaeological results do not necessarily confirm Witter's land-use model, but they do not contradict it either.

Witter and Hughes (1983: 12-13) also propose another factor in site location – that of cold air drainage. According to this hypothesis, on the plains Aboriginal sites are found adjacent to drainage channels partly because of proximity to fuel, and partly because the denser vegetation is where bodies of warm air still develop in the morning. In hilly country, sites will more often occur on low ridges or benches overlooking water courses that are away from the cold night air flowing into the valleys. As topography increases, sites tend to be above the cold air drainage but below the cloudy inversion layer. Consequently a north east aspect becomes important. Witter and Hughes' (1983) survey results supported this concept.

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Table 2: AHIMS Registered Sites within the Search Area for Stage 1 – Wagga Wagga to Bethungra

Site No.	Site name	MGA Easting *	MGA Northing *	Site type**	Description	Status***
50-5-0003	Junee BY 5			Water Hole; Open Camp Site	Site consists of a 100 x 50 m area of exposed granite bedrock in the bottom a drainage line. A number of holes up to 190 mm diameter that *may* be Aboriginal water source. Also a 2 x 2 m water hole. Also quartz fragments near granite boulders adjacent creek – no sign of tools though.	Valid. However, confirmation of site as an Aboriginal site was recommended (Witter 1980).
50-5-0004	Billabong Creek Illabo BY6			Open Camp Site	Site consists of stone tools and debitage of mainly quartz, but some quartzite,"chert" and "slate" material, covering 80 x 20 m area. Site adjacent channel of Billabung Creek anabranch.	Valid. Recommended total surface collection and testing, especially for early dates (Witter 1980) – no record of such. Photographs of pipeline trench attached to site card suggest that trenching occurred prior to any testing or salvage.
50-5-0005	Billabong Creek BY 7			Open Camp Site	A scatter of mainly quartz, but some quartzite, "black chert/slate" and "soft slate" artefacts (mainly debitage, but two hammerstones and five cores recorded). Also thermally fractured rocks (hearth stones). Site nominally covers some 500 x 100 m along Billabung Creek	Valid. Recommended for surface collection and study of (?)hearthstones (Witter 1980). Photos attached to site card suggests collection and excavation completed.
50-5-0006	Bethungra BY 8			Open Camp Site	Scatter of mainly quartz, but also "hornfels" and "chert" in a 26 x 10 m area on a low ridge parallel to Ullandra Creek. Site heavily disturbed by rabbit warren, which seems to have brought up the stone artefacts. Evidence of a charcoal lens – unclear whether bushfire or hearth activity.	Valid. Recommended total surface collection, auger testing and limited salvage excavation (Witter 1980) – no record of such.

Site No.	Site name	MGA Easting *	MGA Northing *	Site type**	Description	Status***
50-5-0008	Junee BY 15 Wanitool Creek			Open Camp Site	Scatter of artefacts covering 540 x 120 m on escarpment of ridge overlooking Wanitool Creek. Assemblage includes about 13 quartz and "hornfels-like" flakes, silcrete core, quartzite pebble tool and a small quartz horsehoof-like artefact.	Valid. Recommended total surface collection and test pitting on Wanitool Creek bank (Witter 1980) – no record of such.
50-5-0009	Harefield Bucks Creek BY4			Open Camp Site	A site measuring some 850 x 50 m on south bank of Bucks Creek including four hearths and clusters of stone artefacts of quartz, silcrete, chert and chalcedony (Witter 1980).	Excavated by Kelly (1980); all surface artefacts in Zone A collected.
50-5-0011	Harefield BY3 Reedy Creek			Open Camp Site	Scatter of quartz flakes, cores and fragments, and burnt clay hearth scatter, on a farm track on evenly sloping hillside of small drainage valley; granite hills. Site covers 400 x 100 m (although only 400 x 3 m visible in farm track). The map provided with the site card is somewhat confusing.	Valid. Recommended total surface collection and test pitting (Witter 1980) – no record of such.
50-5-0036	Illabo-Tumut Pipeline Site IT2			Open Camp Site	A scatter of three stone artefacts covering 5 x 2 m in a large exposure adjacent to a drainage line.	Valid. Recommended monitoring during land clearing (ERM 1999).
50-5-0037	Illabo-Tumut Pipeline Site IT1			Open Camp Site	A scatter of two quartz flakes covering 20 x 5 m area on a track adjacent to a drainage line.	Valid. Recommended no action necessary (ERM 1999).
50-5-0038	Bethungra Scarred Tree			Scarred Tree	A scarred tree in the middle of a creek channel.	Valid. No impacts but monitoring recommended (Edmonds 1999).
50-5-0076	Illabo-Tumut Pipline Site:IT1			Open Camp Site	A scatter of two quartz flakes covering 20 x 5 m area on a track adjacent to a drainage line.	Valid. Consent to Destroy application Aug 2000 (ERM 1999) -

Site No.	Site name	MGA Easting *	MGA Northing *	Site type**	Description	Status***
50-5-0078	OS - 1 Witter 1980, BY 6			Open Camp Site	Additional information to accompany AHIMS #50-5-0004. Two to four quartz and quartzite stone artefacts (hammerstones, anvilstone, millstone) in highly disturbed colluvial terrace on south/west bank of Billabung Creek.	Valid. Recommended avoidance where possible (Kelton 2006). Test excavations were conducted in the area by auger holes under a research permit (#2278) issued to Transgrid.
50-5-0079	OS - 2			Open Camp Site	Two quartz and black chert stone artefacts (hammerstone & flake) in highly disturbed alluvial terrace between two branches of Billabung Creek.	Valid. Recommended avoidance where possible (Kelton 2006).
50-5-0080	OS - 3			Open Camp Site	Three quartz and quartzite stone artefacts in a 10 x 2 m area on the south side of Junee-Eurongilly Road on a ridge crest. (Two artefacts were apparently recorded previously by Witter (1980)).	Valid. Recommended avoidance where possible (Kelton 2006).
50-5-0081	OS - 4			Open Camp Site	At least three artefacts of quartz and volcanic material on a hill crest 1.5 km north of Junee Road.	Valid. Recommended avoidance where possible (Kelton 2006).
50-5-0082	QS - 1			Stone Quarry	An area of "Pleistocene alluvial gravel" extending 700 m along the pipeline easement on north side of Billabung Creek.	Valid. Recommended avoidance where possible (Kelton 2006).
50-5-0083	BY5			Water Hole	Additional information to accompany AHIMS #50-5-0003. Possible Aboriginal rock wells located on a granite platform in the bed of an ephemeral un-named creek.	Valid. Recommended avoidance (Kelton 2006).
56-1-0043	East Bomen 1			Isolated Find	Surface scatter of approx. 500 stone artefacts covering an area of 150 x 70 m, along the crest and upper slopes of the main ridgeline. Site card identifies site as an "isolated find" but the accompanying report says it is a "surficial hardstone quarry" and axe manufacturing site.	Valid. Recommended to preserve site (Navin Offcer 1998).

Site No.	Site name	MGA Easting *	MGA Northing *	Site type**	Description	Status***
56-1-0045	East Bomen IF1			Isolated Find	Site consists of a single banded chert broken flake on the top of a contour bank.	Valid. No previous recommendations made (Navin Officer 1998).
56-2-0001	Shepherd Siding BY2			Open Camp Site	Site covers an area of 550 x 400 m associated with an ephemeral drainage valley amongst low, flattish granite hills. Site consists of a burnt clay hearth, a partial charcoal hearth and about 30 quartz fragments along the gully bank.	Destroyed. Recommended total surface collection and limited salvage of hearth (Witter 1980). NPWS letter dated 12/1/81 indicates that an attempt to salvage the site was too late before pipeline trenching was conducted. Salvage of visible material was completed. Subsequent inspection during field survey revealed some artefacts on the surface of the pipeline easement.

* For confidentiality reasons, the location coordinates for these sites have been omitted from the public exhibition version of this report; they were retained in the government agency version.

** See footnote for **Table 1**.

*** The AHIMS database contains a field describing the current status of a registered Aboriginal site. “Valid” means the site is still current. Other status descriptors include “destroyed”, and “partially destroyed”. The status of the sites in this AHIMS search was not clear. DECCW was contacted on several occasions in an attempt to determine the current status of the sites, but there was no response. The “valid” status shown here is based on the site cards obtained for the sites which do not show that they were destroyed. However, it is likely that where the 1980 pipeline passed through an identified Aboriginal site, that site was, at a minimum, “partially destroyed”.

2.3.4 Predictive Model of Site Location

Material evidence of Aboriginal occupation is one indicator of the significance of an area to the Aboriginal community, and is the principle evidence used by archaeologists. Physical signs of Aboriginal occupation vary in type, location and extent. However, from current knowledge of the Aboriginal occupation in the South West Slopes and Plains, it is possible to draw predictions regarding the likelihood of finding sites in the study area. The predictive modelling in this project is based on associations between environmental features and Aboriginal site types established in local and regional studies. This was followed by a physical inspection of the study area to verify those sites and to locate and record any new sites.

There are several factors that can affect or constrain where Aboriginal people are most likely to have been, where they have left evidence of their activities and/or the degree to which that evidence might be observable in the present material record. Such constraints for Aboriginal people are largely environmental factors such as availability of permanent or ephemeral water, availability of food resources, availability of material resources (e.g. suitable rock sources) and shelter from sun, wind or rain. However, appropriate geomorphological attributes also contribute to site preservation. The interplay of these factors allows certain types of material culture evidence to be retained in the environment.

The potential for finding Aboriginal sites in the study area can be summarised as follows:

1) ***Stone artefacts***: stone artefact sites may occur as either single artefacts (or 'isolated finds') or as 'artefact scatters,' which are generally defined as two or more artefacts within 50 m of each other, or a concentration of artefacts at a higher density than the surrounding 'background scatter.'

   Artefact scatters can represent evidence of camp sites, hunting or gathering events, event sites (such as stone tool manufacture) or as transitory movement through the landscape. An artefact scatter may consist only of material on the ground surface, which has been exposed by erosion forces, or it may be indicative of a sub-surface deposit.

   However surface evidence (or the lack of surface evidence) does not necessarily indicate the potential, nature or density of sub-surface material. Extensive excavations have shown that areas with no surface evidence often contain sub-surface deposits buried beneath current ground surfaces.

   Stone artefacts, whether isolated finds or artefact scatters, are likely to occur in the study area along gentle to very gentle gradient spurs, along ridge crests or along the simple slopes that characterise much of the study area. It is predicted that higher densities of stone artefacts are likely to occur within close proximity to higher stream order watercourses. It is these areas that are considered likely to have evidence of repeated occupation. Away from these higher order watercourses, including along low order watercourses, evidence may still be found but is likely to be the result of periodic low-frequency occupational activity or travel.

2) ***Scarred Trees:*** scarred trees are commonly found in NSW and many are recorded in the South West Slopes and Plains region; however they are more commonly found in the northern part of the region. Scarred trees can be either culturally, naturally or accidentally produced. Cultural scars can be either Aboriginal or European in origin. Scars may be formed accidentally by passage of farm machinery or some other form of impact. Scars can also occur naturally as a result of trauma, storm activity (e.g. lightning strikes), fire, fauna activity (e.g. insects, termites, birds and stock), impact and abrasion, ring-barking and other farmland or woodland management activities.

   Aboriginal scarred trees occur in many environmental contexts and their presence or absence cannot be reliably predicted. While only a low proportion of mature trees (older than 220 years) bear scars that can reliably be identified as Aboriginal in origin, the actual proportion has not been quantified and cannot be accurately predicted.

   The study area has been largely cleared of its native vegetation in the past century and there is a lack of mature trees in the area. This means that scarred tree occurrence is highly unlikely, although it is possible that mature trees do still occur in some parts of the study area, particularly along the margins of watercourses (third-order creeks or larger) where native riparian vegetation has been retained.

3) ***Quarry Sites***: a lithic quarry is the location where a source of raw stone material is exploited (Hiscock and Mitchell 1993: 32). Quarry sites will only occur where there are exposures of a stone type suitable for manufacture of stone implements.

   Lithic quarries are only likely to exist in the study area where outcrops of a suitable raw material exist. Considering the underlying geology of the region, the potential for lithic quarry sites to occur in the study area is considered to be low.

4) ***Grinding Grooves/Engraving Sites***: Grinding grooves are elongated narrow depressions, usually formed in soft sedimentary rocks (e.g. sandstone), and generally associated with water courses. Grinding grooves are usually formed by the shaping and sharpening of ground-edge axes.

   Occurrence of these types of sites relies on the presence of outcrops of sedimentary bedrock. The underlying bedrock, consisting of large expanses of coarse granite, suggests that there is a low potential for such sites to occur in the study area.

5) ***Stone Arrangements***: These sites include mounds, circles, lines or other patterns of stone arranged by Aboriginal people for cultural purposes. Some were associated with ceremonial sites and others were associated with mythological or sacred sites. Hill tops, ridge crests and valley flats that contain outcrops of stone or surface stone, and have been subjected minimal impacts from recent land-use practices, are potential locations for this type of site. Given that the study area has been subjected to severe surface disturbance for the construction of the existing pipeline and optical fibre cable, the potential for such sites to remain in the pipeline easement is considered to be low.

6) ***Bora Grounds***: These sites are generally large circles of raised earth of varying diameters used for ceremonial purposes. The soil was scraped to form a ring. Typically, the Bora ground consisted of a pair of earth circles, the large circle being associated with a smaller circle situated perhaps 300 m away. The two circles were joined by a pathway. The smaller circle sometimes contained an inner circle formed from trees stood upside down with their roots intact. The earth circles were often accompanied by carved trees and/or ground carvings.

   Given that the study area has been subjected to severe surface disturbance for the construction of the existing pipeline and optical fibre cable, the potential for such sites to remain in the pipeline easement is considered to be low.

7) ***Mythological/Traditional Sites***: mythological sites may occur anywhere in the landscape, although such sites are often located at natural landscape features. Other sites of contemporary significance include massacre sites (locations of violent clashes between early settlers and Aboriginal people), traditional camp sites and contact sites. Consultation with the local Aboriginal community is required to identify these types of site.

8) ***Burials***: Aboriginal people tended to place human remains in hollow trees, caves or sand deposits. Burials are usually only detected when eroding out of creek banks or sand deposits or when disturbed by development. The likelihood of detecting burial sites during archaeological survey is very low.

   Although the potential for burial sites to occur in the study area is considered to be low, their presence cannot be discounted.

A review of previous archaeological work in the region can be used to develop an understanding of Aboriginal site patterning. Aboriginal sites can be found in any landform context, but a predictive model seeks to identify landforms that provide the most likely locations where Aboriginal artefacts may be found. These include:

- the banks of major rivers;
- the banks and floodplains of major and minor water courses;
- areas of lower, mid and upper slopes where these slopes are in close proximity to water courses;
- the crests of low ridges or spurs in close proximity to water courses; and
- elevated areas adjacent to natural water bodies (e.g. swamps, billabongs and water holes).

3.0 Methodology

AECOM undertook a two-part investigation of the study area in accordance with the DECCW's *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005).

The assessment was also conducted in accordance with appropriate State legislation, namely the *NSW National Parks and Wildlife Act 1974* and *Heritage Act 1977*, and relevant guidelines, specifically the *Aboriginal Cultural Heritage Standards and Guidelines Kit* (NPWS 1997), the *Interim Community Consultation Requirements for Applicants* (DEC 2004) (ICCRs) and the *Heritage Manual* (Heritage Office 1996).

3.1 Assessment Guidelines

As mentioned above, this investigation was made in reference to the DECCW *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005). These guidelines are specifically tailored to the impact assessment of projects being assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. The guidelines involve a two-stage process:

- *Preliminary assessment* which is primarily a desktop assessment involving the examination of information required to understand the cultural landscape, including the physical setting, history of the peoples living in the landscape, current knowledge of cultural and social values and the material evidence (archaeology). The purpose of the preliminary assessment is to determine whether Aboriginal cultural heritage values are likely to be affected by a development proposal; and
- *Full assessment*, which includes full consultation with the Aboriginal community (as per the ICCRs) and field investigation to identify and record sites of Aboriginal cultural heritage significance.

The methodology AECOM used to fulfil the DEC (2005) guidelines is outlined below.

3.2 Preliminary Assessment

The first stage consisted of a preliminary (desktop) assessment to identify whether any Aboriginal and/or historic heritage values are associated with the study area. As per the DEC (2005) guidelines, AECOM also undertook consultation with relevant Aboriginal stakeholders during this phase. AECOM undertook the following tasks during the initial investigation:

- consultation with relevant Aboriginal stakeholders in accordance with the *Interim Community Consultation Requirement for Applicants* (DEC 2004) (**Section 4.0**);
- an Aboriginal site and report keyword search of DECCW's AHIMS database for the study area and surrounding environment (**Section 2.3**);
- a search of the Register of National Estate (RNE) and the State Heritage Register (SHR) and Inventory (SHI) (**Section 6.0**);
- a search of relevant local planning instruments for listed items of heritage significance (**Section 6.0**);
- a review of existing Aboriginal and historic heritage assessments and documents for the study area and nearby region to provide a regional and local picture on the heritage issues likely to occur in this area (**Section 2.3**); and
- preparation of a predictive model of Aboriginal site location (**Section 2.3.4**)

Under the Part 3A heritage assessment guidelines (DEC 2005) if no Aboriginal heritage constraints are identified at this stage then no further assessment is required. However the initial investigation identified that Aboriginal heritage constraints existed including a number of previously recorded Aboriginal sites in the path of the development. Therefore a more detailed Aboriginal heritage assessment was warranted.

3.3 Full Assessment

The second part of consisted of a more detailed Aboriginal and/or historic heritage assessment, including detailed background research, field investigation, significance assessment, impact assessment and identification of mitigation options as a result of the constraints identified as part of the initial investigation.

3.3.1 Field Survey

The method used for the field survey included identifying areas of heritage constraint based on the presence of appropriate landforms including water courses, alluvial terraces and flats, and ridgelines, spurs and elevated areas associated with, or in close proximity to, water courses. A series of transects were devised that sampled a range of landforms within the study area (**Table T1**, **Figure F4** to **Figure F8**). A total of 18 transects were surveyed during the Stage 1 assessment. The transects were selected using Witter's (1980) land use model, together with the predictive model in **Section 2.3.4**, to identify areas where archaeological evidence is most likely to be found. The transects were designed to sample a range of landforms including a range of water courses (of varying stream order classes) and associated alluvial flats and terraces, slopes, ridge crests and or hill tops. A system of archaeological terrain units, comprising discreet landform elements with a range of slope classes, was devised for the study area (after Kuskie 1999). The terrain units identified in the study area, together with the level of sampling in each terrain unit, are described in more detail in **Section 5.2.1**.

It was not the intention of this assessment to survey the entire study area. Rather, a sampling strategy was devised that investigated a range of different landforms in order to obtain data that would be used to identify the patterning of Aboriginal activity across the landscape. Although a 100% coverage of the pipeline route was not considered warranted (see **Section 5.2.1**), 100% survey coverage of the pipeline easement was achieved within the 18 transects surveyed. However it should be noted that *effective* coverage of 100% was not achieved due to visibility issues (see **Section 5.2.2**). While survey effort was concentrated within the pipeline easement, survey was also conducted along the banks of larger water courses to a distance of 100 m either side of the easement boundary. This was conducted to identify any Aboriginal sites that may occur outside the easement but may be affected by construction activities within the easement, and was particularly relevant where previously recorded Aboriginal sites (AHIMS-listed) covered large spatial extents.

Transects were walked on foot with archaeologists and Aboriginal stakeholders walking in line-abreast at 5 m intervals across the pipeline easement (for specific methodologies on engaging Aboriginal stakeholders, see **Section 4.0**). At creek crossings, participants traversed up one creek bank and down the other before continuing on along the pipeline easement. All Aboriginal stakeholders carried pin flags which were used to mark any artefacts that were found. Archaeologists then followed up with assessment and recording of all identified artefacts. Stone artefacts were identified on the basis of known diagnostic attributes (Holdaway and Stern 2004).

Notes on landform, soils and surface exposure were recorded. Records consisted of descriptive notes, Global Positioning System (GPS) positions (MGA format), and photographs. Where artefact scatters were recorded, the spatial extent of visible artefact material was identified and recorded in descriptive notes, and a central GPS coordinate taken to locate the site for site card purposes.

A survey methodology statement was devised and sent to all registered Aboriginal stakeholders prior to the survey commencing (further detail in **Appendix D**).

3.3.2 Definition of "Aboriginal Site"

Typically, Aboriginal "sites" are defined by the physical extent of visible artefactual evidence (i.e. the extent of visible artefacts lying on the ground surface). The boundary between two sites is often taken to be 50 m (i.e. if two artefacts are within 50 m of each other they are deemed to be part of the same site). In this assessment, Aboriginal sites[2] were defined using the typical approach; that is, site extents were limited by the *visible* extent of archaeological material, where those materials are within 50 m of each other. Sites recorded more than 50 m away were recorded as a separate site.

Furthermore, it should be noted that visible materials on the surface are usually part of a subsurface deposit that have come to the surface through the agency of either erosion or colluvium. Except in the case of colluvial activity, these deposits are often a continuum of materials within a particular landform, an important factor to consider when devising management options for an Aboriginal site.

3.3.3 Cultural (Social) Assessment

One of the aims of this assessment was to identify *archaeological* issues for the study area (i.e. archaeological 'sites' or material evidence such as stone tools, scarred trees, or other tangible evidence of Aboriginal or historic occupation). This is a major focus in an archaeological investigation.

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[2] Note that the *National Parks and Wildlife Act 1974* does not provide protection for nor defines "Aboriginal site". Protection is afforded to Aboriginal "objects" (i.e. artefacts) regardless of the physical location of the objects.

However, the concept of Aboriginal heritage is not confined to material evidence. Instead, it is much broader in scope, encompassing such factors as language, stories and ritual. To investigate Aboriginal heritage values *not* related to archaeological sites relies on contact with the local Aboriginal community for advice. The usual avenue for this is to follow DECCW's guideline on Aboriginal community consultation for Part 6 approvals – *Interim Community Consultation Requirements for Applicants* (ICCRs) (DEC 2004). Details of the consultation process undertaken as part of this preliminary assessment are provided in **Section 4.0**.

All Aboriginal stakeholders were asked for preliminary advice on the cultural significance values of the study area as part of the methodology statement. This was then reiterated throughout the fieldwork, whereby Aboriginal stakeholders were asked and encouraged to provide information on the cultural heritage values of the study area as a whole and of the sites they were involved in assessing. Furthermore all participants were encouraged to provide that information at any stage of the project. To date there has been little to no advice provided by the Aboriginal stakeholders.

In light of the limited responses from the Aboriginal stakeholders regarding this project, there was limited information regarding the cultural (social) values of the study area, and identified Aboriginal sites, to the Aboriginal community. Therefore, in the main, the investigation has focussed on the identification of Aboriginal heritage values relating to archaeological sites. Field survey methods were adopted to verify existing Aboriginal site records, investigate and record new (unregistered) Aboriginal sites, ensure their accurate recording and provide sufficient background information to provide an assessment of cultural significance to the extent that surface survey allows.

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4.0 Aboriginal Community Consultation

Aboriginal community consultation was undertaken in accordance with the ICCRs and DECCW's *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005). These guidelines outline a process of inviting Aboriginal groups to register their interest in being party to consultation (including local newspaper advertising), seeking responses on proposed assessment methodology, and seeking comment on proposed assessments and recommendations. The guidelines require proponents to allow ten working days for Aboriginal groups to respond to invitations to register, and then 21 days for registered Aboriginal parties to respond to a proposed assessment methodology.

An Aboriginal community consultation log is attached at **Appendix C**.

4.1 Notification and Registration of Interest

The ICCR process for this project included the following:

- advertisement of the project in the *Daily Advertiser* newspaper on Saturday 22 August 2009, inviting Aboriginal groups to register interest;
- letters were sent to the following organisations requesting advice on Aboriginal stakeholders to consult and any known heritage issues to be taken into consideration (mailed or faxed 21 August 2009):
    - Department of Environment, Climate Change and Water (DECCW);
    - Wagga Wagga Local Aboriginal Land Council (WWLALC);
    - Young Local Aboriginal Land Council (YLALC);
    - Native Title Services;
    - Office of Registrar for Aboriginal Owners;
    - Wagga Wagga City Council;
    - Junee Shire Council;
    - Cootamundra Shire Council;
    - Harden Shire Council;
    - Young Shire Council; and
- known Aboriginal organisations and individuals around the study area were contacted, as a result of advice received from the above organisations (refer **Table 3**).
- DECCW responded initially to the request by email on 28 August 2009 to indicate receipt of the request for information. DECCW's Queanbeyan Office followed up with a list of four potential Aboriginal stakeholder groups. Of these, Pejar LALC and Cowra LALC were not relevant to the study area and consequently were not consulted. Similarly, the study area is not within Gundungarra Country and so Gundungarra Aboriginal Heritage Association were not consulted. YLALC had already been consulted.

Native Title Services did not respond to a request for information faxed to their office on the 21st of August 2009.

The Office of Registrar for Aboriginal Land Claims responded on 1 September 2009 advising that a search of the Register indicates that there are no Registered Aboriginal Owners.

The Junee Shire Council responded on 28 August 2009 with one recommended Aboriginal individual for consultation (Shirley Buckley) within the Junee LGA however attempts to contact Ms Buckley were not successful. The Harden Shire Council responded by email on 8 September 2009 advising that two LALCs are relevant to their LGA boundary: the eastern and southern part of the LGA is covered by Onerwal LALC and the northern part by Young LALC. As the pipeline route only traverses Young LALC area, Onerwal LALC was not consulted. The Wagga Wagga, Cootamundra and Young Councils did not respond.

As a result of this process, and after the 10-day response period required under the ICCRs, a total of 19 Aboriginal groups registered their interest in being consulted.

Table 3: Aboriginal Stakeholders Identified for this Project

Organisation	Contact Name
Wagga Wagga Local Aboriginal Land Council (WWLALC)	Lorraine Lyons
Young Local Aboriginal Land Council (YLALC)	Norma Freeman
Individual	Enid Clarke
Individual	Keith Freeman
Individual	Krystal Ingram
Individual	Barry McDonnell
Individual	Isobel Charles
Individual	Ramsay Freeman
Individual	Peter Williams
Individual	Janice Considine
Individual	Shirley Marlow
NSW Aboriginal Land Council - Wiradjuri Region (NSWALC)	Craig Cromelin
Individual (also known as HaddiGaddi Koori Services (HGKS))	Dean Freeman
Individual	Neville Williams
Individual	Shawn Williams
Individual	Wayne Williams
Individual	Sharon Williams
Individual	Mitchell Cutmore
Individual	Stuart Cutmore

4.2 Briefing and Methodology Advice

Briefing letters were sent to all 19 registered Aboriginal groups and individuals 7 September 2009 advising the proposed methodology for the survey (**Appendix D**). The letters advised that the assessment would be conducted in two stages. Stakeholders were asked to provide copies of public liability and workers compensation insurances, CVs of previous relevant work, and evidence of cultural knowledge.

The letter described the fieldwork methodology including the use of a targeted sampling regime that investigates areas of higher archaeological potential including creeklines, ridgetops, hill tops and alluvial flats. The data obtained in the field survey would then be used to interpret the landscape into areas or landscape zones with low, moderate or high archaeological sensitivity. The letter also provided details of site recording details of the heritage assessment report, emphasising the need for Aboriginal stakeholder input. Where no information is provided by the Aboriginal stakeholders, assessment of heritage significance will be based on scientific (archaeological) significance alone.

The letter also included a response form that stakeholders could use to respond to the methodology. The response form provided space for stakeholders to endorse the methodology or to provide feedback on alternative methods, and to provide any information on the cultural (social) values of the study area.

Table 4 provides a summary of the responses received in relation to the briefing/methodology letter.

Table 4: Responses to the Methodology Statement Sent to Registered Aboriginal Stakeholders

Organisation	Contact Name	Date Received	Comment
WWLALC	Lorraine Lyons	-	No response received.
YLALC	Norma Freeman	-	No response received. YLALC forwarded response forms for four individuals - Keith Freeman, Enid Clarke, Krystal Ingram & Barry McDonnell - no CVs, no insurance cover, all support methodology
Individual	Enid Clarke	23/9/2009	Supports methodology, no comments on cultural heritage values, no CV, no insurance.
Individual	Keith Freeman	23/9/2009	Supports methodology, no comments on cultural heritage values, no CV, no insurance.
Individual	Krystal Ingram	23/9/2009	Supports methodology, no comments on cultural heritage values, no CV, no insurance.
Individual	Barry McDonnell	23/9/2009	Supports methodology, no comments on cultural heritage values, no CV, no insurance.
Individual	Isobel Charles	-	No response received.
Individual	Ramsay Freeman	29/9/2009	Rang Ramsay (& Janice Considine) - gave verbal support for methodology.
Individual	Peter Williams	-	No response received.
Individual	Janice Considine	29/9/2009	Rang Ramsay (& Janice Considine) - gave verbal support for methodology.
Individual	Shirley Marlow	-	No response received.
NSWALC	Craig Cromelin	-	No response received.
Individual	Dean Freeman	24/9/2009	Supports methodology, no comments made on cultural values, provided CV and insurance.
Individual	Neville Williams	26/9/2009	No comments made regarding methodology or cultural values, CV attached, insured through Manpower.
Individual	Shawn Williams	28/9/2009	No comments made regarding methodology or cultural values, CV attached, insured through Manpower.
Individual	Wayne Williams	26/9/2009	No comments made regarding methodology or cultural values, CV attached, insured through Manpower.
Individual	Sharon Williams	28/9/2009	No comments made regarding methodology or cultural values, CV attached, insured through Manpower.
Individual	Mitchell Cutmore	28/9/2009	No comments made regarding methodology or cultural values, CV attached, insured through Manpower.
Individual	Stuart Cutmore	28/9/2009	No comments made regarding methodology or cultural values, CV attached, insured through Manpower.

Of the 19 registered stakeholders, six did not provide any response to the methodology statement. Seven stakeholders provided either written or verbal support for the proposed methodology and eight stakeholders responded but did not provide any specific comment.

Furthermore, there were varying degrees of compliance with requests for CVs and insurances, which limited the extent of Aboriginal stakeholder involvement in the fieldwork (see below).

As a result of this stage of the consultation process, and after the 21-day response period required by the ICCRs, at total of 13 Aboriginal community groups provided a response to the methodology. A list of all registered stakeholder responses is provided in **Table 4**.

4.3 Fieldwork

The responses to the methodology statement, together with the provision of CV and insurance information, provided the basis for selecting Aboriginal stakeholders for participation in the fieldwork. Those that provided a response and provided CVs and could demonstrate insurance coverage, were selected for participation in the fieldwork. Those that did not respond, or could not provide CVs or proof of insurance coverage, were not invited to participate in the fieldwork, but may be considered for Stage 2.

A total of 10 stakeholder groups were invited to participate in this project (Stage 1). Due to the limited width of the area to be covered in each transect (20 m wide easement) it was considered that no more than five Aboriginal representatives would be required in any single day. Therefore, with four days allocated for fieldwork, each participant participated over two consecutive days. This process was considered to be the most equitable in terms of sharing the available work with the registered stakeholders. In addition, the length of the stage was increased at the Bethungra end, allowing for the Wagga Wagga LALC to send a representative for that day of the fieldwork.

Table 5 shows the fieldwork schedule and the Aboriginal representatives involved.

Table 5: Aboriginal Representatives Involved in Fieldwork

Day/Date	Name	Organisation	Transects Completed
Tuesday 6/10/2009	Neville Williams	Individual	Transects 1-4
	Sharon Williams	Individual	Transects 1-4
	Shawn Williams	Individual	Transects 1-4
	Wayne Williams	Individual	Transects 1-4
Wednesday 7/10/2009	Neville Williams	Individual	Transects 5-8
	Sharon Williams	Individual	Transects 5-8
	Shawn Williams	Individual	Transects 5-8
	Wayne Williams	Individual	Transects 5-8
Thursday 8/10/2009	Ramsay Freeman	Individual	Transects 9-12
	Janice Considine	Individual	Transects 9-12
	Stuart Cutmore	Individual	Transects 9-12
	Mitchell Cutmore	Individual	Transects 9-12
Friday 9/10/2009	Ramsay Freeman	Individual	Transects 13-15
	Janice Considine	Individual	Transects 13-15
	Stuart Cutmore	Individual	Transects 13-15
	Mitchell Cutmore	Individual	Transects 13-15
	Dean Freeman	Individual	Transects 13-15
Thursday 12/11/2009	Dean Freeman	Individual	Transects 16-18
	David Wilson	WWLALC	Transects 16-18

Several groups that responded to the methodology statement did not provide sufficient information prior to commencement of the Stage 1 survey. However, consultation with these groups/individuals will continue throughout the project and they will be invited to participate in Stage 2 of the project.

Aboriginal Stakeholder Comments Received During and After the Fieldwork

During the fieldwork several comments were received regarding the conduct of the survey:

- Neville Williams queried the rate of pay being offered (specifically the living away from home allowance). This is a commercial arrangement and will not be discussed further here.
- Neville Williams further queried that copies of AHIMS site cards were not provided to stakeholders prior to the survey. Provision of site cards to all stakeholders has not been normal practice and was therefore not done. The methodology statement identified the AHIMS sites and Aboriginal stakeholders had the opportunity to request the site cards prior to survey. No such requests were received. Copies of all site cards were provided in the government agency version of this report at **Appendix B**; they have been removed from this public exhibition version for confidentiality reasons. Since this report will be forwarded to all registered stakeholders for comment, all stakeholders will have the site cards prior to the Stage 2 survey and assessment.
- Janice Considine commented on the lack of a pre-survey stakeholder meeting. She considered that such a meeting would have been beneficial for all stakeholders to meet each other and discuss the project as a group. These comments are noted and a pre-survey meeting will be conducted prior to the Stage 2 survey and assessment.

After the conclusion of the fieldwork, a letter dated 13 October 2009 was received from Neville Williams (**Appendix C**), which raised two issues with the survey:

- survey timing is incorrect resulting in missed sites;
- no foot survey between transects.

AECOM believes that these two issues are directly related (in terms of methodology). The methodology clearly stated that the survey was to be conducted in a “targeted” fashion to sample areas that have the most potential for retaining archaeological material. It should be noted that there was never any intention to survey the whole route of the pipeline. The purpose of the survey was not to identify every Aboriginal site along the route. Rather, the purpose was to identify the patterning of Aboriginal use within the landscape traversed by the pipeline. To achieve this, a series of transects were identified based on topographic features of the survey route, AHIMS records of existing sites and previous archaeological reports to inform a predictive model of site occurrence for the study area. A total of 18 transects were walked on foot sampling a range of landform features including water courses, flats, terraces, slopes, ridges and hills crests, as well as re-identify any previously recorded sites within the easement.

Consequently, driving between identified transects was deemed to be the most suitable method. The Stage 1 survey identified a total of 36 Aboriginal sites either within or in close proximity to the pipeline easement. Of these, 12 were previously recorded sites. Whilst a reasonably large proportion of the study area is currently under crop with zero visibility, a similarly large proportion of the study area was under pasture with reasonable levels of visibility. Further, whilst some areas that were intended to be surveyed (such as along minor drainage lines) could not be surveyed due to restrictions on access within the crops, the proponent has agreed that these areas may be surveyed towards the end of the year once those paddocks have been cleared of crops. A total of five transects are considered suitable for later survey.

Mr Williams was given the opportunity to comment on the survey methodology prior to the survey. He responded to the methodology statement on 26 September 2009, sending in a response form that supplied to him for that purpose. Mr Williams did not provide any comment or objection to the proposed methodology at that time (**Appendix C**).

AECOM considers that the primary aim of the survey was achieved. From the range of sites identified and landforms sampled, AECOM has identified a general model of site patterning within the study area, which will inform the likely impact assessment.

4.4 Circulation of Draft Report

A draft of this report was circulated to the 19 Aboriginal stakeholder groups on 12 January 2010 seeking comments on the results of the survey and assessment, as well seek information to inform a cultural (social) heritage significance assessment.

The comments received are summarised in **Table 6** below.

Response – Neville Williams

Mr Neville Williams responded to the draft report via faxed letter, dated 25 January 2010. Mr William's letter is also sent on behalf of Sharon Williams, Shawn Williams and Wayne Williams. The letter is provided in full in **Appendix C**, but is summarised as follows:

- *Stakeholder meetings*: Mr Williams believes that stakeholder meetings before and during fieldwork would have provided a better forum to discuss the issues, methodology and results of the assessment, and allow for improvements as work progresses. This comment is noted and future works, such as the Stage 2 assessment, will included stakeholder meetings.
- *Methodology*: Mr Williams continues to be concerned about the level of sampling conducted during the survey, particularly given the lack of visibility during the survey.
- *Management Commitments*: Mr Williams states that because the assessment is being conducted under Part 3A, this does not mean that Aboriginal cultural heritage should be treated as if it has little or no significance. Mr Williams states that all Aboriginal Country has significance to Aboriginal people. This report does not suggest that the Aboriginal cultural heritage values of the study area have no significance. Pending input from the Aboriginal community, the report suggests that the sites identified have low scientific or archaeological significance. That is, the sites are commonly found throughout the region, are in a highly disturbed context and are considered unlikely to contribute further information regarding the archaeological signature of the study area. It is acknowledged that all sites have cultural heritage significance to the Aboriginal community.
- *Future action*: Mr Williams has requested a meeting of all stakeholders to discuss the project, the methodology, the management recommendations made in the first stage and further survey/excavation work.

Notwithstanding Mr Williams' comments and concerns, AECOM believes that the assessment is now complete. The sites identified in the survey are of low archaeological significance and further collection, monitoring or other forms of investigation are not considered warranted. Although only one test excavation has been conducted in the easement (Kelly 1980), which was conducted on the fourth-order Bucks Creek, the study was comprehensive and shows that surface evidence in the study area is representative of the sub surface cultural resource. Furthermore, the sites occur in a highly disturbed context and subsurface deposits are considered highly unlikely to remain in context. Therefore there is no justification for test excavation. The proponent is committed to undertaking excavations where there is a reasonable belief that new information will be learned; however, all indications are that the open sites in the study area will not provide such information.

Monitoring is generally not accepted by any construction company these days on safety grounds. Further survey will be undertaken in the areas considered to have archaeological potential, but no monitoring or excavations are warranted. Again, it should be noted that the corridor has already been graded and another pipeline constructed within it, disturbing the archaeological integrity of the easement.

AECOM notes the Aboriginal community request for stakeholder meetings. Such meetings will be held for the next stage.

Table 6: Summary of Aboriginal Stakeholder Feedback on Draft Report

Organisation	Representative	Date Received	Comment
WWLALC	Lorraine Lyons		Did not provide formal comment.
YLALC	Norma Freeman		Did not provide formal comment.
Individual	Enid Clarke		Did not provide formal comment.
Individual	Keith Freeman		Did not provide formal comment.
Individual	Krystal Ingram		Did not provide formal comment.
Individual	Barry McDonnell		Did not provide formal comment.
Individual	Isobel Charles		Did not provide formal comment.
Individual	Ramsay Freeman		Did not provide formal comment, but during a telephone conversation on 28 January 2010 Mr Freeman reiterated that he felt that site APA36 has high cultural heritage significance.
Individual	Peter Williams		Did not provide formal comment.
Individual	Janice Considine		Did not provide formal comment.
Individual	Shirley Marlow		Did not provide formal comment.
NSW ALC -	Craig Cromelin		Did not provide formal comment.
Individual (also known as HGKS)	Dean Freeman		Did not provide formal comment.
Individual	Neville Williams	25/1/2010	Provided clarification on previous comments made. Requests a meeting of all stakeholders to discuss the project, particularly in relation to methodology, further survey work and/or test excavation, monitoring during construction.
Individual	Shawn Williams		
Individual	Wayne Williams		
Individual	Sharon Williams		
Individual	Mitchell Cutmore		Did not provide formal comment.
Individual	Stuart Cutmore		Did not provide formal comment.

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5.0 Aboriginal Heritage Results

This section provides the results of the background research and the fieldwork conducted as part of the assessment.

5.1 Introduction

A series of 18 transects were identified based on topographic features of the survey route, AHIMS records of existing sites and previous archaeological reports to inform a predictive model of site occurrence for the study area. The transects sampled a range of landform features including water courses, flats, terraces, slopes, ridges and hill crests, in addition to re-identifying any previously recorded sites within the easement. This led to a total of 36 Aboriginal cultural heritage sites identified in the course of the survey, which included the previously recorded AHIMS sites.

5.2 Fieldwork Constraints and Opportunities

In addition to the constraints identified in **Section 2.3.4** (e.g. availability of water, food resources, raw materials and shelter) further constraints for archaeologists include the extent to which Aboriginal activity is represented by preserved evidence, the degree to which post-depositional processes have affected the archaeological record, the extent to which land-use (e.g. cultivation or development) has altered the archaeological landscape, the time of year and the conditions under which a survey is conducted.

The study area was located within a cleared easement that had undergone various levels of disturbance by previous land management practices. These easements are covered with low pasture grass and various low weed species to a height of less than 100 mm. Sampling areas (transects) offered varying levels of surface visibility ranging from 0% in heavily pastured areas to up to 40% in areas with less dense growth.

Small ground surface exposures (1 m^2 to 10 m^2) occur sporadically throughout the study area (**Plate P9** and **Plate** P10), with several larger exposures associated with contour banks and stream-banks (**Plate P12**). Contour banks are a modification of the landscape to capture run-off and direct it towards a dam, while stream bank exposures are generally the result of flood-scouring (**Plate P13**). Contour banks and flood-scouring, although offering the best areas of surface visibility, are also a source of sediment loss, and therefore a source of potential impacts on in situ archaeological deposits. In many sample areas there was little surface lithic material evident, even in bare-earth exposures.

5.2.1 Survey Sampling

One of the underlying principles for determining Aboriginal occupation models and spatial patterning is to analyse the archaeological signature in relation to the various landforms present within a study area.

Analysis of the topographic features of the study area identified a total of 15 discreet archaeological terrain units (after Kuskie 1999) based on the type of landform element and the degree of slope. **Table 7** below shows the 15 terrain units, together with the total length of each unit in the study area, the total length sampled in each terrain unit, the total length of each terrain unit estimated to have been under crop during the survey, and the total length of terrain units that are considered to have archaeological potential but were not surveyed due to the presence of crops.

Areas with landforms identified as having high potential in the predictive model (**Section 2.3.4**) were surveyed. Areas that were not surveyed were considered to have low potential; for the most part these are landforms that are either very flat or are generally low undulating lands. However, the majority of transects also sampled areas of low potential; for example the banks of creeks were surveyed and nearby ridges were also surveyed. The lower potential lands in between these two higher potential landforms were also surveyed at the same time. Similarly, some fourth order creeks occur in areas of extensive alluvial flats extending many hundreds of meters from the creek, which is considered to have lower archaeological potential. Large areas of these flats were also sampled during the survey.

Attempts were made to survey all drainage lines identified through remote sensing, including first and second order streams. For the most part first order streams in the study area occur as very shallow depressions without discernible channel. These areas were often covered in standing crops since the absence of a channel does not inhibit cropping. However, the predictive model identifies that the archaeological potential in these areas is low.

Table 7 shows that approximately 27% (16.7 km) of the study area was sampled during the survey, with an additional 5% (3.4 km) that was intended for survey but could not be accessed due to crops. The percentage of each terrain unit sampled ranged from around 5% to 100%. Terrain units considered to have higher archaeological potential (e.g. creek banks, ridge and/or spur crests, and slopes in close proximity to water sources) had a higher percentage of survey effort than those terrain units that are considered to have low archaeological potential (e.g. extensive pasture flats at large distances from creeks or ridges).

Some areas could not be surveyed due to standing crops at the time of the survey. Written advice from DECCW (see Appendix C) suggests that the timing of the survey (i.e. prior to harvest) is unfortunate but unavoidable. Furthermore any archaeological evidence, if it occurs in these areas, will comprise very low numbers of flaked stone artefacts, which are common, and which are well understood archaeologically. Not every single piece of flaked stone needs to be observed and recorded in order to understand that, while small numbers of artefacts may be displaced by the pipeline construction, this is not a significant impact due to their low significance. Surveys cannot all be expected to occur when crops have been harvested.

The predictive model shows that approximately 3.7km of the study area, which was not surveyed due to access restrictions in standing crops, would be of potential interest archaeologically (**Table 7**). These areas occur mainly in the area between Bomen and Harefield. These areas will be surveyed prior to construction.

Areas of higher archaeological potential where crops occurred are generally in the low undulating plains or alluvial flats associated with creeks and/or drainage lines.

5.2.2 Effective Survey Coverage

Effective survey coverage is calculated on the basis of the total area surveyed, exposure and ground surface visibility. This information was recorded for sites and for the sample areas. Because of the nature of the survey (targeted pedestrian) and the proposed development (a linear excavation), and because a representative sample of landscape units were recorded, an analysis of the 18 sample areas (transects) provides the basis for assessing effective survey coverage along the route. The effective cover calcultation for each transect is shown in **Table T1** in the **Tables Section** at the back of this report. Details of ground surface visibility and effective survey coverage for each transect are provided (**Table 8**).

Effective survey coverage is a function of the amount of ground surface available for detecting surface artefacts. The amount of ground surface visibility is determined by the amount of ground cover (vegetative cover) over the entire transect, the number and total area of exposures in the transect, and the amount (area) of those exposures with bare soil visible. As can be seen **Table 8** below, the majority of transects had ground surface visibility (and therefore the area of each transect available for detecting artefacts of less than 50%. A total of eight transects (44%) had a ground surface visibility of less than 10%. As it was still relatively cool at the time of survey and there had been some recent rainfall ground layer species throughout the study area had grown to provide reasonable pasture with varying ground coverage. Wheat crop hampered survey in various parts of the study area as farmers would not allow access through areas under crop. Even if access through cropped areas could have been negotiated, visibility would have been zero due to the density and height of the crop.

Table 7: Assessment of Landforms in the Study Area and Percentage of each Landform Sampled

Landform	Total length in study area (km)	Survey Sample		Landform under crop during survey		Landforms still to be surveyed due to crops	
		Total Length (km)	Percentage of total study area (%)	Estimated Total Length (km)	Percentage of total study area (%)	Total Length (km)	Percentage of total study area (%)
Flats, developed	0.75	0.00	0.00	0.00	0.00	0.00	0.00
Flats, pasture	14.05	0.70	4.98	7.50	53.38	0.00	0.00
Flats, alluvial	6.40	2.43	37.97	3.86	60.31	0.50	7.81
Simple slope (v. gentle)	17.56	2.15	12.24	1.00	5.69	1.40	7.97
Simple slope (gentle)	11.15	5.00	44.84	2.15	19.28	0.70	6.28
Simple slope (moderately steep)	1.40	1.10	78.57	0.00	0.00	0.00	0.00
Spur crest	2.35	1.85	78.72	0.20	8.51	0.15	6.38
Ridge crest	1.95	0.20	10.26	0.00	0.00	0.00	0.00
Hill crest	0.35	0.35	100.00	0.00	0.00	0.00	0.00
Drainage depression (V. gentle - 1st order)	2.46	0.90	36.59	0.36	14.63	0.26	10.57
Drainage depression (Gentle - 1st order)	1.85	0.40	21.62	0.00	0.00	0.00	0.00
Drainage depression (Gentle - 2nd order)	0.15	0.00	0.00	0.15	100.00	0.15	100.00
Drainage depression (V. gentle - 2nd order)	0.80	0.80	100.00	0.00	0.00	0.00	0.00
Drainage depression (V. gentle - 4th order)	0.60	0.60	100.00	0.20	33.33	0.20	33.33
Drainage depression (moderately steep)	0.20	0.20	100.00	0.00	0.00	0.00	0.00
Total	**62.02**	**16.68**	**26.89**	**15.42**	**24.86**	**3.36**	**5.42**

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Table 8: Ground Surface Visibility Classes

Exposure Area	No. of Transects	Percentage
< 0.01%	0	0
0.01 – 1.0%	0	0
1.01 – 10.0%	8	44
10.01 – 50.0	9	50
50.01 – 100.0%	1	6
Total	**18**	**100**

As a result of the relatively low level of ground surface visibility, effective survey coverage was generally very low, with eight transects having an effective coverage of 1.0% or less. All 18 transects had an effective coverage of 10 percent or less (**Table 9**). This result could be extrapolated to the entire study area; in other words the effective coverage of the study area was less than 10%. Effective cover for each transect is shown in **Table T1** at the back of this report.

Table 9: Effective Cover Classes

Effective Cover Class	No. of Transects	Percentage
< 0.01%	0	0
0.01 – 1.0%	8	44
1.01 – 10.0%	10	56
10.01 – 50.0	0	0
50.01 – 100.0%	0	0
Total	**18**	**100**

Whilst some of the study area is inaccessible and under crop with zero visibility, much of the study area was under pasture with greater levels of visibility. Further, whilst some areas that were intended to be surveyed (such as along minor drainage lines) could not be visited due to restrictions on access within the crops, and difficulties negotiating site access our client has agreed that these areas may be surveyed towards the end of the year once those paddocks have been cleared of crops.

5.3 Findings

A total of 36 Aboriginal sites with artefactual evidence were located in the course of the survey. The sites consist of low density artefact scatters (n=30) and isolated finds (n=6) (**Table 10**).

Table 10: Site Types Identified within the Study Area

Site Type	Number	Percentage
Isolated Find	6	17
Artefact Scatter	30	83
Total	**36**	**100**

Detailed descriptions of all sites can be found in **Section 5.5** and in **Table T2** at the end of this report. All sites identified in the survey were assigned a unique identification number, with Aboriginal sites prefixed “APA.” **Table** 11 lists each site and its site type.

Table 11: Sites Identified in Study Area

Site ID	AHIMS No.	Site Type	Landform Element/s
APA 1		Artefact Scatter	Plain
APA 2		Artefact Scatter	Mid slope
APA 3		Artefact Scatter	Mid slope
APA 4	50-5-0082	Artefact Scatter	Lower slope
APA 5	50-5-0005	Artefact Scatter	Stream bank, Terrace Flat
APA 6	50-5-0004; 50-5-0078;	Artefact Scatter	Stream bank, Terrace Flat
APA 7		Artefact Scatter	Lower slope, Stream bank
APA 8		Artefact Scatter	Lower slope
APA 9	50-5-0079	Artefact Scatter	Terrace Flat
APA 10		Isolated Find	Mid slope
APA 11		Artefact Scatter	Flat
APA 12	50-5-0008	Artefact Scatter	Upper slope
APA 13		Artefact Scatter	Lower slope
APA 14	50-5-0080	Artefact Scatter	Lower slope
APA 15		Isolated Find	Flat
APA 16		Artefact Scatter	Undulating plain, Stream bank, Stream channel
APA 17		Artefact Scatter	Stream bank, Stream channel
APA 18		Artefact Scatter	Stream bank, Stream channel
APA 19		Artefact Scatter	Mid slope
APA 20	50-5-0003; 50-5-0083	Artefact Scatter; *possible* Aboriginal water holes	Lower slope, Stream bank, Stream Channel
APA 21		Artefact Scatter	Lower slope, Stream bank
APA 22	50-5-0009	Artefact Scatter	Ridge, Stream bank, Terrace Flat
APA 23		Artefact Scatter	Valley flat
APA 24	50-5-0009	Artefact Scatter	Stream bank, Terrace Flat.
APA 25		Artefact Scatter	Valley flat
APA 26		Artefact Scatter	Valley flat

Site ID	AHIMS No.	Site Type	Landform Element/s
APA 27		Isolated Find	Valley flat
APA 28		Isolated Find	Valley flat
APA 29	56-2-0001	Artefact Scatter	Valley flat, Stream bank, Stream channel
APA 30		Isolated Find	Ridge crest
APA 31		Artefact Scatter	Mid slope, Upper slope, Ridge
APA 32		Artefact Scatter	Lower slope
APA 33		Artefact Scatter	Upper slope
APA 34		Isolated Find	Lower slope
APA 35		Artefact Scatter	Mid slope
APA 36		Artefact Scatter	Hill crest

5.3.1 Summary

Of the total 62 km of proposed pipeline, a total of 16.7 km was walked to a width of up to 15 m either side of the existing easement. Some of the transects were in the vicinity of previously recorded AHIMS sites, and in each case where a site was re-located additional information was recorded.

5.4 Identified Aboriginal Cultural Sites

The following section describes Aboriginal cultural heritage sites identified in the course of the field survey. A total of 36 Aboriginal sites were identified in the course of the survey of the pipeline route. Many of the sites have been previously recorded by Witter (1980) and Kelton (2006), but during the course of the fieldwork the opportunity was taken to update site information current condition of the site (see **Figure F4** to **Figure F8**) for graphical representations of site locations in relation to the pipeline easement). For confidentiality reasons, the exact location of the sites have not been depicted in this public exhibition version of the report.

MGA coordinates were recorded using a GPS and were presented in the government agency version of this report; they have been removed from this public exhibition version for confidentiality reasons.

APA1 Artefact Scatter

This site consists of a scatter of nine artefacts made from various types of raw material. Present were four flakes made of black volcanic material as well as a silcrete flake and several pieces of quartz. It was located in an exposure approximately 50 x 10 m.

APA2 Artefact Scatter

This site consists of two flaked pieces located in a 20 x 20 m exposure next to a large tree. The artefacts are located either side of the original pipe trench.

APA3 Artefact Scatter

This site consists of two flaked pieces located in exposures associated with vehicle tracks which run along the pipeline easement. It is on a gently sloping spur crest facing south west. Vegetation consists of low pasture up to 100 mm with visibility at 20%, site is located in a 10 x 2 m area.

APA4 Artefact Scatter

Originally recorded as an isolated find adjacent to the east bank of Billabung Creek by Witter (1980). The site was re-recorded by Kelton (2006) as a possible quarry site for Pleistocene alluvial gravel procurement measuring some 700 m in length up a gentle slope, ending at gas marker "85.3". This survey identified two artefacts in close proximity to Witter's original record. The site consists of one quartz flake and one grinding dish 10 m apart on a bare earth track on the east side of the creek's boundary fence, and approximately 10 m south of the current pipeline alignment.

APA5 Artefact Scatter

This site was previously recorded by Witter (1980) and subsequently excavated by Kelly (1980). This survey identified a scatter of quartz, quartzite, slate and silcrete flakes and flaked pieces as well as a possible grinding stone in exposures resulting from cattle pads and vehicle tracks. A total of 22 artefacts were recorded in a 100 x 100 m area centred over the pipeline easement. The area has been extensively disturbed by ploughing, pipe construction and excavation.

APA6 Artefact Scatter

This site is probably an extension of the sites originally recorded by Witter (50-5-0004) and Kelton (50-5-0078), although it is on the opposite side of Billabung Creek (eastern side) and marginally more than 50 m away. This survey identified a total of 10 quartz flaked pieces and one silcrete flaked piece on a contour bank on the alluvial terrace flat (**Plate P14**). The site covers an area of approximately 20 x 6 m; surface visibility was about 80%.

APA7 Artefact Scatter

Site APA7 is located on an eroding creek bank on western side of Billabung Creek (Western Branch). The site was previously recorded by Witter (50-5-0004) as an 80 x 20 m exposure with one tool, two cores and 27 pieces of flaked debitage. This survey identified a total 21 artefacts in an area of 60 x 20 m, some of which were not conclusively diagnostic. The hammerstone identified by Witter (1980) was not re-identified. Kelton (50-5-0078) identified 2-4 artefacts about 35 m north of the pipeline route (outside the easement).

APA8 Artefact Scatter

This site is an artefact scatter on contour bank used to drain water off the hillside into the dam within a 1st order drainage line. Three quartz flaked pieces identified in an area 20 x 3 m (although possibly extending further). The contour bank is on the eastern side of the drainage line on a lower slope and was amongst crops during the survey.

APA9 Artefact Scatter

This site is part of site 50-5-0079 recorded by Kelton (2006). Kelton's site card suggests that the site runs the extent of the terrace between the two branches of Billabung Creek, although he only recorded two artefacts. This recording identified a further three artefacts in a 75 x 25 m area between an internal property fence and the west branch of the creek. Visibility in the low pasture of the paddock was approx. 40%. The site card for 50-5-0079 indicates that some auger test excavations were carried out.

APA10 Isolated Find

This site consists of an isolated silcrete flake in an exposed vehicle track adjacent to fenceline, located approximately 100 m east of a contour bank on the east side of a 1st order drainage depression. The site is outside the impact area of pipeline works.

APA11 Artefact Scatter

This site consists of a small scatter of four quartz artefacts in a 10 x 10 m area, within a 20 x 20 m exposure with 70% visibility. The exposure is located on the existing pipeline route approximately 50 m east of a dam.

APA12 Artefact Scatter

This site was recorded by Witter (1980) consisting of a large, low density scatter of 13 flakes over an area of 540 x 120 m from Oades Lane down a NW-SE facing spur crest. The pipeline crosses this site near Oades Lane. This survey identified six artefacts along the spur line (within Witters original site area) and a further seven artefacts along the pipeline easement in an area of 130 x 20 m extending from Oades Lane to a point approximately 20 m SE of a mid-slope gas marker. The site consists of quartz and quartzite flakes and flaked pieces. The upper slope is littered with numerous quartz and quartzite gravel and pebbles, many of which demonstrate shatter attributes.

APA13 Artefact Scatter

This site consists of two quartz artefacts recorded consisting of one quartz flake and one quartz flake with evidence of backing. The site covers a 100 x 20 m area commencing 15 m NE of a dam and finishing within a fenced laneway to the north of Wantiool Creek. The site is in the vicinity of existing site 50-5-0008, but further downslope within the pipeline easement. The slope is covered in low pasture with 40% visibility.

APA14 Artefact Scatter

This site was original recorded by Kelton (2006) as a 10 x 2 m area consisting of three artefacts including a hammerstone/manuport. This survey identified a total of 27 flakes, flaked pieces and cores made from mostly quartz and one instance of chert. The site occupies an area of some 260 x 50 m extending SE from the Junee-Eurongilly Road to Witter/Kelton's original recording. The area has been highly disturbed by cultivation and previous trenching from pipeline and optical fibre cable construction.

APA15 Isolated Find

This site consists of large pointed slate flake with possible retouch on one edge found on western edge of a farm track just inside gate on south side of drainage depression, approx 2 m from the creek edge. The site is outside the pipeline easement.

APA16 Artefact Scatter

This site is located within a dam on a 1st order drainage depression with areas of exposure on the dam bed and within the entrance channel. The dam straddles the drainage depression. At the time of the survey, the paddocks either side of the drainage line had wheat crops with zero visibility. The site is approx 20 x 3 m in extent within an exposure of 60 x 3 m. Seven quartz and quartzite flakes were recorded amongst a scatter of slate gravel material. The site is within the dam enclosure on the southern side. At the time of the survey, the dam was mostly empty. The site is outside the pipeline easement and will not be affected by construction.

APA17 Artefact Scatter

This site is a small stone artefact scatter measuring 5 x 1 m in an exposure measuring 20 x 3 m on the southern bank of a 1st order drainage depression, approx 10 m west of a paddock fenceline. Visibility in the exposure was 90%. A total of four quartz artefacts were recorded. The site is outside the pipeline easement and will not be affected by construction.

APA18 Artefact Scatter

This site consists of small clusters of quartz artefacts on both sides of a 1st order drainage line in and around a dam straddling the creek. The site is in areas of exposure from within the dam enclosure to 20 m downstream of the dam. Exposure 1 contains seven quartz and slate artefacts in an area 4 x 50 m within and adjacent to the dam. Exposure 2 is located on a contour bank on the north side of the drainage depression and measures 3 x 60 m. It contains two clusters of artefacts each containing two quartz flakes.

APA19 Artefact Scatter

This site consists of three quartz artefacts in a 6 x 1 m site area located on an S-shaped exposure measuring 50 x 5 m. The exposure is approximately 10 m SE of a contour bank with a gas marker post. Visibility within the exposure was 40%. The site is approximately 90 m upslope to the north of existing site 50-5-0003/50-5-0083.

APA20 Artefact Scatter; *Possible* Aboriginal Water Holes

This site was originally recorded by Witter (50-5-0003) and re-recorded by Kelton (50-5-0083). Witter identified what are possibly Aboriginal waterholes in an area of granite bedrock in the bed of a creek. The site also identified several quartz fragments amongst granite boulders on the lower slopes above the creek, but none had definite flaking attributes. The western edge of the granite platform has been blasted during construction of the previous pipeline/optic fibre cable. This survey identified a single quartz flake on the northern side of the creek bed (**Plate P15** and **Plate P16**).

The ‘waterholes’ at APA20 appear to be a natural feature and were registered in AHIMS as *possible* Aboriginal waterholes. There is no archaeological evidence that they were used by Aboriginal people in antiquity, nor was any noted by Witter when he recorded them. On this basis there is no secure basis for claiming the waterholes are an Aboriginal object as defined under the *National Parks and Wildlife Act 1974*. There is no evidence, either archaeologically or culturally, that the site has ceremonial or mythological significance.

APA21 Artefact Scatter

This site consists of eight quartz flakes and flaked pieces in an area measuring 50 x 20 m straddling both sides of a 1st order drainage line up to 10 m either side. The drainage line has moderately sloping banks with erosion and several exposed contour banks. Visibility was 40% in exposed areas and 20% in pasture areas. Total exposure area is 2,500 sq m. The site is approximately 160 m SE of existing site APA 20 (50-5-0003/50-5-0083).

APA22 Artefact Scatter

This site was originally recorded by Witter (1980) as an extensive low density artefact scatter along Bucks creek measuring 850 x 50 m. The extent of the site was delimited by boundary fences and is thought to continue further. Site consists of the remains of four hearths, six stone tools and a range of other stone artefacts (debitage) made from mostly quartz, but with silcrete, chert-slate and chacedony. This survey remained within the pipeline easement and identified seven quartz artefacts on an exposure on the southern side of the creek. No evidence of hearths were observed in the pipeline easement.

APA23 Artefact Scatter

This site consists of four quartz artefacts in an area measuring 150 x 20 m along the pipeline easement in a recently ploughed field offering 100% visibility, on the northern side of Pattersons Lane at Harefield. The artefacts included three flaked pieces, a core and a flake. The field had a scatter of quartz gravel throughout.

APA24 Artefact Scatter

This site consists of three quartz artefacts identified along the banks of Reedy Creek, which may form part of site 50-5-0009, although the site card was unclear as to the exact extent of that site. The area consists of scatters of quartz gravel and pebbles in the pipeline easement. One quartz flake and three quartz flaked pieces were recorded in the easement in a 50 x 10 m area on both sides of the creek on the flats within 3 m of the creek banks.

APA25 Artefact Scatter

This site consists of a quartz flake and a quartz core on a farm track in a paddock within valley flats. The site is 10 x 2 m approx 10 m NE of gas marker "115.3".

APA26 Artefact Scatter

Area of exposure located on dam wall and along edges of a 2nd order drainage line (a branch of Reedy Creek). An area of 300 sq m exposed with 100% visibility. Low pasture elsewhere with <10% visibility. The site extends 100 x 15m on both sides of the channel, in and around the dam, and probably extends further into areas of low exposure. Thirteen quartz artefacts were recorded here. There is also a possible knapping floor on the south side with seven smokey grey quartz flakes and flaked pieces featuring different material to that present elsewhere. A possible hammerstone was found here measuring 72 x 43 x 32 mm.

APA27 Isolated Find

This site consists of one quartz flaked piece located 15 m east of a mid-paddock gas pipe sign, approx 1/3rd of the way between two drainage depressions. The site is probably part of previously recorded site 56-2-0001 which was recorded as having an area of 550 x 400 m on the northern drainage depression.

APA28 Isolated Find

This site consists of a single quartz flaked piece amongst an area of quartz gravel and pebbles on an exposed cattle track (50 x 0.3 m) with 80% visibility. The site is located 100 m south of a 2nd order drainage depression and 200 m SE of a dam that straddles that depression. The site is probably part of previously recorded site 56-2-0001 which was recorded as having an area of 550 x 400 m on that drainage depression. The site area recorded in this survey was 5 x 1 m.

APA29 Artefact Scatter

This site was previously recorded by Witter (1980) in a 2nd order drainage line, which was recorded as having an area of 550 x 400 m on that drainage depression, including a burnt clay hearth, a partial charcoal hearth, and approximately 30 quartz debitage artefacts. A large dam has been constructed within the drainage depression, and exposures include the dam wall, adjacent contour banks and dam edges, with a total exposure of approx

2000 sq m. The observed site extent was 50 x 10 m with 80% visibility. Three quartz flaked pieces and five quartz gravel pieces were present. The AHIMS site card recommended total surface collection and limited excavation, but NPWS letter says archaeologists arrived too late to conduct salvage. Limited surface collection was undertaken. Witter's (1980) site map bears little resemblance to the site today.

APA30 Isolated Find

This site consists of one quartz flaked piece (debitage) on a farm track approximately 6 m at 260°M from a grain bin. The site is 150 m east of the pipeline route, therefore well outside the pipeline easement and will not be affected by construction.

APA31 Artefact Scatter

This site consists of three quartz artefacts amongst many large quartz gravel/cobbles scattered all the way down a moderately steep spur crest/slopes from a large water tank at the hill crest down to the boundary fence. The site covers an area of 30 x 10 m on the mid-slope area of the spur crest, approx 200 m downslope of the water tank. Artefacts include two quartz flakes and a quartz flaked piece.

APA32 Artefact Scatter

This site consists of two quartz flaked pieces, approx 20 m apart, on the optical fibre cable trench mound clearing. The exposure for the mound is 1.25 m wide with >80% visibility. The artefacts are likely to have been surfaced through previous trenching and, although in the current easement, are likely to be out of impact zone for this project.

APA33 Artefact Scatter

This site consists of two quartz flakes located 10 m east of the optical fibre trench mound (and on the mound itself) on a very gentle upper slope just below a ridge crest. The exposure for the mound is 1.25 m wide with >80% visibility. The site area covers approximately 20 x 2 m.

APA34 Isolated Find

This site consists of one quartz flake on vehicle or cattle track 40 m east of a dam (which is on a 1st order drainage depression). The track is 2 m wide with 80% visibility. The site is in the pipeline easement on a gentle lower slope.

APA35 Artefact Scatter

This site consists of a small artefact scatter on the edge of contour bank, midslope above the confluence of two 1st order drainage depressions. Six quartz artefacts are present in a site area approx 20 x 20 m. The main exposure is a contour bank 1 m wide with 60% visibility and on a vehicle/cattle track 2 m wide with 60% visibility.

APA36 Artefact Scatter

This site consists of a scatter of artefacts on the crest of hill amongst heavy granite boulder outcropping (**Plate** P17). A series of small exposures of less than 1 sq m includes three quartz cores and five quartz flaked pieces, most of which is attributable to debitage (**Plate P18**). The site was identified by Ramsay Freeman as being of possible cultural significance due to its extensive outlook over valley flats to the south and west (**Plate** P19). This is based on the area's location rather than the archaeological material observed. The site is not considered to have ceremonial or mythological significance.

5.5 Discussion

A total of 24 previously unidentified Aboriginal sites were identified within the 17 km of the pipeline route covered by this survey (26% of the entire 62 km study area). The Aboriginal sites were predominantly artefact scatters (n=30) with the remainder being isolated finds (n=6) (**Figure F4** to **Figure F8**).

In order to discuss the distribution of sites found along the route, a number of analyses were undertaken to explore the factors affecting site location. Ground visibility, existing land-use impacts, taphonomic factors, stream order and distance to water were analysed in terms of site type and the size of artefact scatters. These analyses were based on the data derived from the site and sample area recordings. The results of these analyses are summarised as follows:

- of all the sites recorded, relatively few (n=5, 14%) were found in close proximity to a reliable water source with stream order ranking of 4 or higher (Billabung Creek) (**Table 12**);

- eighteen sites (50%) were located in the vicinity of an ephemeral water course (i.e. stream orders with a ranking of 3 or lower) (**Table 12**). By far the majority of sites are associated in close proximity to an ephemeral water source.
- the majority of sites consisting of a single stone artefact (isolated finds) were associated with ephemeral, low order water courses, or far enough away from any watercourse to be unrelated. Most artefact scatter sites were associated with a stream of some nature, generally a lower order one (**Table 12**);
- of the sites identified in the survey, the highest proportion were "artefact scatters" (n=26), 72% while "isolated finds" made up the remainder of the sites (n=6; 28%) **Table 12**). However, in all four cases the "artefact scatters" consisted only of a maximum of two artefacts, suggesting that artefact densities in the study area are generally low;
- in relation to distance from a water source, over two thirds (n=23; 70%) were found within 50 m of a water source. The remainder (n=11; 30%) were found further than 50m from the nearest water source (**Table 13**);
- visibility throughout the study area caused a general limitation on the potential for site discovery. The sample area data, being based on a random selection of landscape contexts, provides the best indications for overall visibility along the route. From this, it is clear that visibility along the route was generally very poor, with 96% of transects having less than 10% visibility;
- no part of the proposed route could be described as 'undisturbed'. Levels of disturbance along the route varied, but most sites were located in highly disturbed contexts, which were only associated with vegetation clearance and minor pastoral/agricultural infrastructure works. Those in the pipeline easement had been subject to disturbance in various forms from previous pipeline construction;

Table 12: Number of Aboriginal sites showing stream order and site type

Stream Order	Isolated Find	Artefact Scatter	Total
N/A	4	1	5
1	3	15	15
2		4	4
3		4	4
4		5	5
Total	**7**	**29**	**36**

Table 13 Number of Aboriginal site types identified at increasing distances from water sources

Distance to water source (m)	Isolated Find	Artefact Scatter	Total
0-10	2	12	14
11-20		1	1
21-30		7	7
31-40		1	1
41-50		2	2
51-100	1	3	4
101-200		2	2
Total	**3**	**28**	**31**

In areas where the soil is bare but not heavily eroded, surface evidence (or lack thereof) can sometimes be an unreliable guide to subsurface archaeological content. The lack of surface lithic material evident in the many surface exposures of the study area does not necessarily mean that there are no sub-surface artefacts. However, the lands within the easement have already been extensively impacted by construction of the previous pipeline.

Archaeological material is already noted in areas identified in the predictive model. The nature of the material suggests that artefacts are generally typical quartz artefacts found commonly throughout the region. Given the previous disturbance of the easement, it is not considered that subsurface testing will provide any further information. From a scientific point of view, such a program is not considered warranted. Any subsurface artefacts will have already been displaced by the previous pipeline construction within the easement and therefore any significance based on spatial patterning would have already been diminished. It follows that excavation would simply confirm what is already accepted – that stone artefacts occur at places within the easement.

5.5.1 Scarred Trees

The easement is virtually cleared for most of its length due to the previous stripping of the top soil during the previous pipeline construction. Very few areas of the easement have standing vegetation within; where standing vegetation exists, it is mostly regrowth with very few mature trees. Where mature trees occurred, they were checked for scars. No evidence of cultural scarring was found.

5.5.2 Rocky Outcrops

Rocky outcrop areas may contain spiritually significant Aboriginal objects such as stone arrangements. All areas of rocky outcrop identified by remote sensing were surveyed. The easement (for the most part) avoids rocky outcrop areas since these areas are more difficult to construct in. Within this stage of the pipeline, rocky outcrop areas occur in three main areas: 1) the area NE of Bethungra; 2) the area NE of Harefield; and 3) a small area NE of Bomen (APA36). These areas were all surveyed and no archaeological evidence of ceremonial sites were identified.

Furthermore, in areas where the easement passes through rocky outcrop areas, the construction method used in previous pipeline and/or optical fibre cable laying included blasting to trench through the bedrock. In such cases any evidence of stone arrangements is likely to have been destroyed.

5.6 Aboriginal Site Potential in Unsurveyed Areas

As discussed in **Section 3.1** the field survey used a targeted sampling approach to identify Aboriginal sites within the pipeline corridor, and areas where potential archaeological deposits may occur. This section provides a general Aboriginal site location model covering areas of the study area that were not surveyed. As the survey covered a range of landform types and identified Aboriginal sites in varying numbers across these landforms, some general predictions may be made on the results.

5.6.1 Unsurveyed Areas

A number of sections of the proposed pipeline easement could not be included in the heritage assessment because the land to be surveyed was under crop and therefore unable to be surveyed. These sites are marked as to be revisited in **Figure F4** to **Figure F8**.

5.6.2 Aboriginal Site Patterning

From the results in **Section 5.3** it can be seen that open artefact scatters are the main Aboriginal site type likely to be encountered in the study area. They appear to be found in three contexts:

1) in areas of greatest water reliability, particularly in association with higher order water courses (≥ stream order 4); and
2) on lower to mid foot slopes that overlook a water source, but are slightly elevated to avoid periodic flooding; and
3) near more ephemeral drainage lines subject to occasional water flow.

Sites on ridge tops were less common during the survey; indicating that sites on ridge tops in the study area are rare. However, such sites are commonly found on this type of landform elsewhere, particularly where low ridges are in close proximity to reliable water. It is worth noting that one of the potentially more culturally significant sites in the study area, APA 36, was located on a ridge crest. The paucity of sites in the study area is probably due to poor ground surface visibility during the survey, or due to the reliability of water (see Witter's occupation model in **Section 2.3.3**).

5.6.3 Review of Predictive Model

The patterning of Aboriginal site locations allows the development of a general Aboriginal site location model covering areas of the study area that were not surveyed. While it is accepted that Aboriginal people lived in all areas of the environment and left evidence in all parts of the landscape, this discussion focuses on landscape areas where past repeated Aboriginal activity left the most obvious and enduring archaeological signature, suitable for interpretation and heritage management.

Open sites, comprising stone artefacts on the open ground, or as subsurface deposits, are likely to occur within 200 m of a high order creek or river on a range of landforms including creek banks, creek flats and terraces, lower slopes and ridges overlooking water sources. Smaller open sites may also occur near ephemeral low order streams, but are unlikely to occur where those water sources are first order streams with no defined channel. These sites are likely to occur on largely undisturbed ground that has not been disturbed by building, road or dam construction or landscaped areas.

With relatively few stone artefacts located during the survey, and with few sites previously located and recorded, actual artefact densities within the study area cannot be made with any accuracy. All studies to date, including this study, indicate that artefact densities are likely to be very low (probably $<1/m^2$).

These results conform to Witter's (1980) occupation model that suggests that Aboriginal land use was generally restricted to well-watered areas. Areas that have correspondingly less water (e.g. ephemeral headwaters) will retain fewer artefacts due to the limited and periodic use of the area only when water is plentiful.

6.0 Historic Heritage Results

AECOM undertook a search of the NSW Heritage Branch (DoP) heritage database on 21st August 2009 for the Wagga Wagga, Junee and Cootamundra Local Government Areas (LGAs). This search identified a total of 228 items within these LGAs, which are summarised below in **Table 14.** The vast majority of sites listed are in the towns in each LGA, such as Junee and Wagga Wagga.

Table 14 Historic Heritage Items listed in the LGAs traversed by the study area

LGA	No. of Historic Heritage Items Listed						
	SHR	s.170	LEP/Gaz	RNE	CHL	NHL	Total
Wagga Wagga	4	13	6	19	0	1	43
Junee	5	5	141	13	1	0	165
Cootamundra	2	5	0	12	0	1	20
Total	**11**	**23**	**147**	**44**	**1**	**2**	**228**

Out of the 228 items identified in the LGAs, only two are within a 2km buffer of the pipeline easement. Both are items related to the Main Southern Railway and as such are located within the rail corridor and therefore will be not be impacted by the pipeline. These items are shown in **Table 13**

Table 15: Historic Heritage Listed Items within 2km either side of the pipeline easement.

Item Name	Address	LGA	Register					In the study area?
			SHR	S.170	Gaz	LEP	FED	
Bomen Railway Station	Main Southern Railway, Bomen	Wagga Wagga	☑	☑		☑		No
Bethungra Spiral	Main Southern Railway, Bethungra	Junee	☑	☑				No

6.1 Historic sites identified in the course of the field survey

A historic sites survey was conducted by Rick Bullers and Peter Howard as part of the field surveys running from the 6th October 2009 to the 9th October 2009 as well as the second round of surveys conducted on the 12th of November 2009. During the course of these surveys no historic items were located within the pipeline easement. This is not unexpected as the pipeline avoids built-up areas and homesteads in order to minimise any impact or complications associated with properties along the easement.

The Bethungra Spiral is located within 300 m of the pipeline easement at its closest point, however as this is still well outside the study area and works are limited to the pipeline easement, no impact will occur and no further analysis will be required.

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7.0 Heritage Significance Assessment

This section provides an assessment of the heritage significance of the study area within a local, regional and national framework.

7.1 Principles of Assessment

Heritage sites, objects and places hold value for communities in many different ways. The nature of those heritage values is an important consideration when deciding how to manage a heritage site, object or place and balance competing land-use options. The many heritage values are summed up in an assessment of “Cultural Significance”.

The primary guide to management of heritage places is the Australia ICOMOS *Charter for Places of Cultural Significance* (The Burra Charter) 1999. The Burra Charter defines cultural significance as follows:

> *Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations.*
>
> *Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.*
>
> *Places may have a range of values for different individuals or groups.*

This assessment has sought to identify heritage objects and sites within the study area and obtain enough information to allow the values of those objects and sites to be determined.

The criteria for the assessment of the ‘heritage significance’ of Aboriginal sites are the site’s scientific and educational significance and social/cultural value. This section is therefore divided into two distinct parts, a scientific assessment and an Aboriginal cultural assessment of social value. The former is undertaken by the archaeologist and investigates the scientific importance of the sites identified, while the latter is provided by discussions and input from the relevant Aboriginal stakeholders.

7.2 Scientific (Archaeological) Value

Scientific value is assessed according to the research potential of a site. Rarity and representativeness are also related concepts taken into account. Research potential or demonstrated research importance is considered according to the contribution that a heritage site can make to current understanding of human society and the human past. Heritage sites, objects or places of high scientific significance are those that provide an uncommon opportunity to inform us about the specific age of people in an area, or provide a rare glimpse of artistic endeavour or provide a rare chronological record of changing life through deep archaeological stratigraphy.

The comparative rarity of a site is a consideration in assessing scientific significance. A certain site type may be “one of a kind” in one region, but very common in another. Artefacts of a particular type may be common in one region, but outside the known distribution in another.

The integrity of a site is also a consideration in determining scientific significance. While disturbance of a topsoil deposit with artefacts does not entirely diminish research value, it may limit the types of questions that may be addressed. A heavily cultivated paddock may be unsuited to addressing research questions of small-scale site structure, but it may still be suitable for answering more general questions of implement distribution in a region and raw material logistics.

The capacity of a site to address research questions is predicated on a definition of what the key research issues are for a region. In the region the key research issues revolve around the chronology of Aboriginal occupation and variability in stone artefact manufacturing technology. Sites with certain backed implements from the Holocene are very common, but sites with definite Pleistocene evidence are extremely rare, and hence of extremely high significance if found.

Sandra Bowdler and Anne Bickford suggest that the value of a place/object can be judged by answering the following questions:

> *Can the site contribute knowledge which no other resource can?*

Is the knowledge relevant to general questions about human history or other substantive subjects?

To adequately assess significance, evidence is required which includes information about the presence of subsurface deposits, integrity of these deposits, nature of site contents and extent of the site. A review of information about previously recorded sites within the local area and region enables the rarity and representativeness of a site to be assessed see (**Section 2.3**).

High significance is usually attributed to sites that are so rare or unique that the loss of the site would affect our ability to understand aspects of past Aboriginal use/occupation for an area. In some cases a site may be considered highly significant because its type is now rare due to destruction of the archaeological record through development. Moderate significance can be attributed to sites which provide information on an established research question. Low significance is attributed to sites which cannot contribute information about past Aboriginal use/occupation of an area. This may be due to site disturbance or the nature of the site's contents.

7.2.1 Research Potential

This refers to the potential of a particular site or group of sites to answer questions about the past through the use of archaeological methodologies. It concerns the potential to elucidate past behaviour, rather than simply being a route to champion particular methodologies or to facilitate the recovery of large artefact collections.

The study area revealed...

The isolated finds and artefact scatters identified in this study are considered to offer low research potential. These types of site are commonly found throughout the region in the South West Slopes and Plains landscape, and hence have little potential to provide technological and tool information for the local and regional area. The sites have also been subject to high levels of previous disturbance due to the construction of a pipeline in 1980, in some parts of the study area, the trenching and installation of an optical fibre cable in 2006. Artefacts, whether surface or subsurface, are unlikely to be in situ and thus a large part of the sites' archaeological context has been lost.

7.2.2 Representativeness

This category has primary meaning in the context of conservation objectives. In defining a site as 'representative' of a particular type or class, we are seeking to assess whether it should be conserved in order to ensure that we retain a representative sample of the archaeological record as a whole.

The identified sites in this study area are open sites consisting of isolated finds and low density artefact scatters. The sites were found within the modelled thresholds of archaeological deposit. However, the sites have been extensively disturbed by previous pipeline and/or optical fibre cable construction, and possibly through previous land management practices such as vegetation clearance and grazing, and subsequent erosion, particularly stream bank erosion. Thus their potential to be representative of intact subsurface deposits is somewhat compromised. Again, the site types are commonly found in the South West Slopes and Plains landscape. They are, therefore, well represented in the local and regional archaeological record. Consequently, none of the identified sites is considered to have significance value based on representativeness.

7.2.3 Rarity

The criterion of rarity reflects whether the nature of the archaeological site being investigated is common or rare.

The open sites located during the survey, and assemblages they contain, are commonly found within the South West Slopes and Plains landscape. Consequently the identified sites are considered to have low significance value based on rarity.

7.2.4 Educational Potential

This refers to the potential of a site or suite of sites to educate the general public about the Aboriginal past.

The identified sites are not rock shelters containing art or extensive engravings; they are artefactual material situated on or in disturbed contexts and, while interesting to those within the heritage industry and significant to Aboriginal communities, they are of limited value to engage the interest of the general public. The education potential of these sites to the general public is low.

7.2.5 Aesthetic Significance

Aesthetic significance is generally taken to mean the visual qualities of a place. This value is not considered to be inherent in a place but arises from people's individual perception of a particular place. Furthermore, different cultures can have very different expectations of what constitutes an 'aesthetically pleasing' aspect of a site or landscape.

From an archaeological and earth science perspective, the study area has been impacted by previous land use and processes that have adversely impacted aesthetic values.

7.2.6 Conclusion

The sites found during the heritage assessment of the pipeline survey were either single stone artefacts, or very low density stone artefact scatters. The survey was largely restricted to the pipeline easement, which was subject to very heavy disturbance over its extent during previous pipeline and optical fibre cable construction activities. With this in mind, any site located within the pipeline easement must be considered to have been subject to such a level of disturbance to render it completely out of context.

In light of this, these sites must be assessed as offering little potential for advancing scientific knowledge of the Aboriginal occupation of the local area or region. On that basis the sites found in the study area are considered to offer no scientific value.

7.3 Cultural (Social) Value

Aspects of social significance are applicable to sites, objects and landscapes that are important to the local Aboriginal community. The importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for sites generally and their continued protection.

Aboriginal sites with archaeological evidence are all of value to the Aboriginal community because they represent a tangible connection with pre-European Aboriginal life. For this reason, we often report what we perceive to be the social value of a site to the Aboriginal community based on their comments and advice.

Local Aboriginal community groups were consulted regarding the methodology used in this assessment and, wherever possible, involved in the field survey. Prior to the field survey, all registered Aboriginal stakeholders were requested to provide information on the cultural heritage values of the study area.

In acknowledgement that the Aboriginal community themselves are in the best position to identify levels of cultural significance a copy of this draft report will be distributed to the Aboriginal stakeholders involved in the project and their comments on values, both social and cultural, will be incorporated into the assessment prior to its finalisation.

Social/Cultural Significance Assessment

During the initial consultation process there were few views expressed by the Aboriginal community on the cultural value of the study area. Aboriginal stakeholders were asked several times for details of any known socio-cultural values of the study area: 1) on initial invitation to register interest (LALCs); 2) as part of the methodology comment process; 3) during fieldwork itself; and 4) during draft report review.

There is no mention of significant sites in the *Wiradjuri heritage study* (Go Green Services 2002).

There are no registered Aboriginal Places in the study area (DECCW website).

It should be noted that the lack of "results" or confirmation of spiritual sites should not be taken to be a trigger for further consultation until results are found. It is taken to demonstrate the lack of spiritual sites and the assessment has been concluded on that basis.

A copy of the draft of this report was circulated to registered Aboriginal stakeholders after the completion of fieldwork to seek their input. Comments from that draft are summarised below and shown in **Table 16**.

In his response to the draft report, Mr Neville Williams (also on behalf of Sharon, Shawn and Wayne Williams) reiterated that all Aboriginal Country is significant to the Aboriginal community. No specific comments were made regarding the cultural significance on individual sites, but Mr Williams has requested a stakeholder meeting to discuss the project further.

During the fieldwork Mr Ramsay Freeman identified APA36 as a site of possible cultural heritage significance, based on the extensive outlook the site has to the south and west. Mr Freeman was contacted again on 28

January 2010 to gain further information on this site. He stated that, in his opinion, the site is of very high significance value to the Aboriginal community due to its outlook over a large alluvial plain and creek, the presence of granite outcropping, and the archaeological material found at the site. There is no suggestion by Mr Freeman that the site has ceremonial or mythological significance.

7.4 Summary of Significance

This section presents a summary of Aboriginal heritage significance of the study area. This significance assessment can be considered a combination of the scientific and socio-cultural values, or an overview of the importance of a particular area through Aboriginal heritage sites and places. The subsequent retention or manipulation of these values will be the rationale behind the management strategy presented in **Section 9.2**.

Table 16 below gives the significance assessment of the Aboriginal sites identified during the heritage investigations.

On scientific (archaeological) basis the sites in the study are considered to have low significance due their low potential for expanding knowledge of Aboriginal occupation of the region. However all sites are considered to be of high cultural heritage significance to the Aboriginal community because Aboriginal sites, and the material evidence they contain, provide a link because they provide a tangible connection with pre-European Aboriginal life.

Table 16: Summary of Significance Assessment

Site ID	AHIMS No.	Site Type	Scientific (Archaeological) Significance					Socio- Cultural Significance
			Research Potential	Represent-ativeness	Rarity	Educational Potential	Aesthetic Significance	
APA 1		Artefact Scatter	A scatter of nine artefacts made from various types of raw material. Likely highly disturbed by original pipeline construction: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 2		Artefact Scatter	This site consists of two flaked pieces located either side of the pipe trench. Likely high disturbance: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 3		Artefact Scatter	Two flaked pieces located in erosion associated with vehicle tracks. High disturbance: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 4	50-5-0082	Artefact Scatter	A quartz flake and grinding stone on an exposed track. Likely highly disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 5	50-5-0005	Artefact Scatter	A total of 22 artefacts recorded in an environment which was highly disturbed by pipeline trenching: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 6	50-5-0004; 50-5-0078;	Artefact Scatter	Low density quartz scatter with little of diagnostic value: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 7		Artefact Scatter	Low density scatter consisting mostly of debitage with a tool and two cores. Likely heavily disturbed due to original pipeline construction: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*

Site ID	AHIMS No.	Site Type	Scientific (Archaeological) Significance					Socio- Cultural Significance
APA 8		Artefact Scatter	Three artefacts recorded. Very low density. Likely heavy disturbance due to pipeline construction: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 9	50-5-0079	Artefact Scatter	Flaked debitage on a modified contour bank. Artefacts disturbed and likely present due to water action: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 10		Isolated Find	Isolated find in a vehicle track. *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 11		Artefact Scatter	Low density scatter. Likely heavily disturbed due to pipeline construction: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 12	50-5-0008	Artefact Scatter	Large low density scatter recorded by Witter (1980). Many cobbles show evidence of heat shatter, although the site is not disturbed by pipleline construction: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 13		Artefact Scatter	Two flakes, one with evidence of backing in a 100 x 20 m area: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 14	50-5-0080	Artefact Scatter	27 artefacts recorded in addition to Kelton's three (2006). Extensive cultivation and trenching disturbance: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 15		Isolated Find	Large flake in farm vehicular track. Possible evidence of retouch. Disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*

Site ID	AHIMS No.	Site Type	Scientific (Archaeological) Significance					Socio- Cultural Significance
APA 16		Artefact Scatter	Low density scatter in a dam and on a dam wall. Heavily disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 17		Artefact Scatter	Small scatter with four artefacts in a drainage depression. Outside pipeline easement so not disturbed by trenching: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 18		Artefact Scatter	Small clusters of quartz artefacts in an area heavily disturbed by damming and pipeline construction: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 19		Artefact Scatter	Low density scatter in close proximity to existing pipe: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 20	50-5-0003; 50-5-0083	Artefact Scatter; *possible* Aboriginal water holes	Little definite physical cultural evidence present, possible waterholes in granite bedrock. Extensive blasting in the vicinity but not in exact location of possible waterholes: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 21		Artefact Scatter	Low density scatter in highly eroded drainage line and contour banks: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 22	50-5-0009	Artefact Scatter	Site originally recorded by Witter in 1980. This visit was unable to re-locate and of the features recorded by Witter. Seven quartz artefacts were found in the easement: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*

Site ID	AHIMS No.	Site Type	Scientific (Archaeological) Significance					Socio- Cultural Significance
APA 23		Artefact Scatter	Three flaked pieces, a core and a flake in a ploughed field with quartz gravel throughout. Extensive disturbance: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 24	50-5-0009	Artefact Scatter	Three quartz artefacts in a creek bank and four quartz flakes in the pipeline easement: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 25		Artefact Scatter	One quartz flake and one core on a farm track within pipeline easement. Heavily disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 26		Artefact Scatter	Thirteen quartz artefacts in an area heavily disturbed by dam construction: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 27		Isolated Find	Single quartz flaked piece in a paddock: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 28		Isolated Find	Single quartz flaked piece in a paddock with quartz gravel: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 29	56-2-0001	Artefact Scatter	Previously recorded site which included full salvage in recommendations. Site was trenched prior to salvage occurring. Three quartz flaked pieces recorded. Heavy disturbance: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 30		Isolated Find	Quartz debitage in farm track: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*

Site ID	AHIMS No.	Site Type	Scientific (Archaeological) Significance					Socio- Cultural Significance
APA 31		Artefact Scatter	Three quartz artefacts on a hill slope: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 32		Artefact Scatter	Two quartz artefacts on the fibre optic cable trench mound. Highly disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 33		Artefact Scatter	Two quartz artefacts on the fibre optic cable trench mound. Highly disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 34		Isolated Find	One quartz flake on a track in pipeline easement. Highly disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 35		Artefact Scatter	Small scatter with six artefacts located in a contour bank and vehicle track. Disturbed: *Low*	Common, disturbed: *Low*	Common: *Low*	*Low*	*Low*	No specific comments made: *High*
APA 36		Artefact Scatter	Three quartz cores and five flaked pieces on a rocky, hill with large boulders. In middle of pipeline easement but areas around boulders are not likely to have been disturbed. *Low*.	Common, disturbed: *Low*	Common: *Low*	*Low*	Promontory with extensive outlook to the south and west: *Moderate*	Considered to be significant by Ramsay Freeman: *High*

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7.5 Historic Heritage

No listed or unlisted historic heritage items were found during the fieldwork. Historic heritage will not be considered further in this report.

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8.0 Impact Assessment

This section provides an assessment of the impacts of the development on the cultural heritage values of the study area.

8.1 Project Construction Details

The project involves the construction of an additional 18 inch 'looping pipeline' parallel to the existing high pressure gas pipeline, constructed in 1980. The pipeline will be located within a 20 m wide easement for a distance of 61 km, creating a study area of 1.22 km^2 (122ha).

Construction of the pipeline will involve clearing and grading the entire pipeline easement, except in limited areas where alternative pipe trenching techniques, such as directional drilling. Such clearing would result in total surface disturbance over the areas where it is employed, which will likely consist of the majority of the route. It is worth noting that the study area has already been subject to such an impact in 1980 when the original pipeline was constructed, and subsequently in 2006 when an optical fibre cable was constructed in part of the study area.

The pipeline trench is constructed by mechanical trenching plant which excavates a (1.2m deep x 0.65m wide) trench, moving the spoil to one side. This method is used everywhere except for major road and watercourse crossings where directional drilling would be employed. Trench cutting through stream and drainage lines is the activity most likely to impact archaeological sites, although the clearing process will destroy all sites recorded on the surface within the easement.

Following the placement of the pipe in the trench, the site will be backfilled and levelled.

8.2 Impacted Area

Table 17: Area of impact from pipeline construction

Impact type	Area
Pipe construction	1.22 km^2 (approx. 61km long by 20 m wide)
Access tracks	Accessed from existing roads
Percentage of study area impacted by ground breaking	100%

8.3 Discussion

Throughout the pipeline survey archaeological sites were identified and recorded with their position relative to the pipeline route. The nature of the impact of the proposed development on heritage sites has been assessed on this basis. The areas sampled were targeted as outlined in **Section 3.2**, with the entire width of the pipeline easement and an additional 15 m either side being covered, as well as an additional 100 m each side of the easement along creek banks.

All sites identified in the study area were visited in the company of members of the local Aboriginal community (refer to **section 4.2**). In the initial round of fieldwork, the Wagga Wagga Local Aboriginal Land Council were unable to attend, but were subsequently present in the second round of fieldwork conducted on the 12 November 2009.

Table T2 at the back of this report shows all Aboriginal heritage sites recorded along the route during the survey.

8.3.1 Open Sites

All sites encountered during the surveys were low density open stone artefact sites. The presence of Aboriginal artefacts on the surface does not necessarily equate to the presence of sub-surface artefacts. However, previous archaeological excavations indicate that artefacts are likely to occur in greater density within the subsoil. Relatively speaking the archaeological footprint of the study area is low, and it is not considered likely that the excavations associated with the pipeline construction will be detrimental to the scientific value Aboriginal heritage, although the surface sites recorded during the survey will certainly be impacted.

As the study area has already been subject to substantial scraping and clearing associated with the initial 1980 pipeline installation any artefacts on the surface could not be considered to have remained in context. This discontinuous nature of the soil profile means the surface gives little indication as to what subsurface deposits may entail, however the potential for archaeological remains is considered to be low.

Thirteen of the existing AHIMS registered sites occur within the pipeline easement. Of these, the sites recorded by Witter (1980) have either been subject to surface collection or salvage, and those which haven't would have been subjected to substantial impact as a result of the initial pipeline construction. The exception to this is site 50-5-0003, which was revisited by Kelton in 2006 (50-5-0083). This site was identified as a possibly culturally significant site in Witter's (1980) study since it contains water holes, although their identification as an Aboriginal site has not been verified. As such the pipeline route avoided any direct impact on the areas identified as potentially significant, although blasting to locate the route has occurred in the immediate vicinity. There is potential for the proposed pipeline to impact the waterhole site since it is on the eastern side of the established pipeline. It is recommended that the stream in which the holes are located is under-bored rather than blasted and trenched.

Sites recorded by Kelton in 2006 are mostly additional information for sites previously recorded by Witter (1980). An additional site was also recorded at 50-5-0079 consisting of three artefacts over a total distance of approximately 500 m. The site card contains photographs of a test excavation using an auger holes, which appears to have come from a report. However the report could not be found within the DECCW reports library.

As outlined in **Section 2.3.4** archaeological sites are likely to occur in the study area near streams and drainage lines, although the density of the scatters in the study area has been consistently low. However, it is considered that the scatters are likely to occur with subsurface deposit.

Other Stone-based Sites

No other stone based sites such as engravings, grinding grooves or rock art were identified in the course of the surveys. As the survey was undertaken using a targeted approach there is a possibility that such sites exist in the study area, although the types of areas where these sites are likely occur, rocky outcrops, were surveyed as part of the sampling strategy.

Ceremonial/Mythological Sites

No evidence of ceremonial or mythological sites was observed during the course of the survey, and the community members consulted did not identify whether any such sites exist in the area. Site APA 20 (AHIMS 50-5-0003; 50-5-0083) was initially recorded in 1980 as a site of *possible* Aboriginal water holes, however there has been no further evidence (either archaeological or cultural) to support this. Based on the current evidence the site is not considered to be either a ceremonial or mythological site. Site APA36 was identified by an Aboriginal community member (Ramsay Freeman) has having high cultural value, however this was based on the site having extensive outlook over a creek plain and not because it was ceremonial or mythological.

8.3.2 Historic Heritage

No existing historic sites were identified within the study area, and no sites were encountered in the course of the surveys. Due to the targeted nature of the survey it is possible that places of historic may occur in the study area which were not identified, however the pipeline route was likely sited to avoid such impacts initially, and as the route traverses open pastoral country the likelihood for historic sites to occur is considered low. A remote survey of the whole pipeline route using Google Earth indicated that there are unlikely to be any historic heritage items within the path of the pipeline construction.

9.0 Applicable Policy and Legislation

9.1 Commonwealth Legislation

9.1.1 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The purpose of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* is the preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters that are of particular significance to Aboriginal people in accordance with Aboriginal tradition.

Under the Act the responsible Minister can make temporary or long-term declarations to protect areas and objects of significance under threat of injury or desecration. The Act can, in certain circumstances, override state and territory provisions, or it can be implemented in circumstances where state or territory provisions are lacking or are not enforced. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander or organisation.

The Act is administered by the Department of the Environment, Water, Heritage and the Arts.

9.2 New South Wales Legislation

The following New South Wales legislation protects aspects of cultural heritage and is relevant to development activities in the study area.

9.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act requires that consideration be given to environmental impacts as part of the land use planning process. In NSW environmental impacts are interpreted as including cultural heritage impact. Three parts of the EP&A Act are most relevant to Heritage. Part 3 relates to planning instruments, including those at local and regional levels; Part 4 controls development assessment processes; and Part 5 refers to approvals by determining authorities.

Part 3A provides an approvals regime applying to all major projects. Major projects are defined under State Environmental Planning Policy (Major Projects) 2005 (SEPP 2005). It also applies to those projects which the Minister believes are required to deliver particular government plans or programs, known as critical infrastructure projects. Part 3A applies to all projects where the Minister has the approval role. Under Part 3A, the Minister can issue a project approval or a concept approval. Both maintain the requirement for consultation with the community and relevant State Government agencies, however the requirement for certain other permits and licences is removed under Part 3A.

Section 75B(2) of the EP&A Act makes provision for ‘major projects’ to be identified through various means, including by way of declaration as a listed project in SEPP 2005, or by notice in the Gazette.

The proposed project is classified as a ‘major project’ under Part 3A.

Under section 75U of the EP&A Act, projects approved under Part 3A do not require a permit under section 87 or a consent under section 90 of the NPW Act. Under the Part 3A provisions, the Minister for Planning is the consent authority and has ultimate responsibility for determining matters relating to Aboriginal heritage. However, for the preparation of an Environmental Assessment, the Director-General will issue environmental assessment requirements under s.75F, in consultation with other relevant public authorities and have regard to the need for the requirement to assess any key issues raised by those public authorities. In practice this usually means that Part 3A still requires assessment of potential impacts to European and Indigenous heritage and such assessment is generally equivalent to the normal assessment process under the NPW Act and Heritage Act.

9.2.2 Heritage Act (1977)

The *Heritage Act 1977* was enacted to conserve the environmental heritage of New South Wales. Under section 32, places, buildings, works, relics, moveable objects or precincts of heritage significance are protected by means of either Interim Heritage Orders (IHO) or by listing on the State Heritage Register (SHR). Items that are assessed as having State heritage significance can be listed on the SHR by the Minister on the recommendation of the Heritage Council.

Archaeological relics (any relics that are buried) are protected as either SHR items or, when not SHR items, by the provisions of section 139. Under this provision it is illegal to disturb or excavate any land knowing or suspecting that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed. In such cases an excavation permit under section 140 is required. Note that no formal listing is required for archaeological relics; they are automatically protected.

Proposals to alter, damage, move, damage or destroy places, buildings, works, relics, moveable objects or precincts protected by an IHO or listed on the SHR require an approval under section 60. Demolition of whole buildings will not normally be approved except under certain conditions (section 63). Some of the sites listed on the SHR or on LEPs may either be ‘relics’ or have relics associated with them. In such cases, a section 60 approval is also required for any disturbance to relics *associated* with a listed item.

9.2.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act), administered by DECCW, is the primary legislation for the protection of Aboriginal cultural heritage in NSW. One of the objectives of the NPW Act is:

> *The conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including but not limited to: (i) places, objects and significance to Aboriginal people…* (s.2A(1)(b))

Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence if impacts are not authorised. An Aboriginal Heritage Impact Permit (AHIP) should be obtained if impacts on Aboriginal objects and places are anticipated. AHIPs can be issued under ss.87 and 90 of the NPW Act.

Sections 86 and 87

Under section 86 of the NSW *National Parks and Wildlife Act 1974* (NPW Act) it is an offence to:

> disturb or excavate any land, or causes any land to be disturbed or excavated, for the purpose of discovering an Aboriginal object; or
>
> disturb or move on any land an Aboriginal object that is the property of the Crown, other than an Aboriginal object that is in the custody or under the control of the Australian Museum Trust.

…except in accordance with the terms and conditions of an AHIP issued under s.87 of the NPW Act.

Section 90

Under section 90 of the NPW Act it is an offence to:

> *knowingly destroy, deface or damage, or knowingly cause or permit the destruction or defacement of or damage to, an Aboriginal object or Aboriginal place…*

…unless under an AHIP issued by the Director-General under s.90, subject to such conditions and restrictions as are specified in the AHIP. Therefore an AHIP issued under s.90 should be obtained if impacts on Aboriginal objects and places are anticipated.

For the purposes of the Act:

- An *Aboriginal object* is any deposit, object or material evidence (that is not a handicraft made for sale) relating to Aboriginal habitation of NSW, before or during the occupation of that area by persons of non-Aboriginal extraction (and includes Aboriginal remains).
- An *Aboriginal place* is a place declared so by the Minister administering the NPW Act because the place is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects.

Consultation with the Aboriginal community is required under DECCW policy when an application for an approval under Part 6 of the NPWS Act or Part 3A of the EP&A Act is considered. The consultation process used in this study is outlined in more detail in **Section 4.0**.

9.3 Local Government

Under the provisions of the EP&A Act, Local Environmental Plans (LEPs) and Regional Environmental Plans (REPs) are prepared by a Local Government Council. An LEP defines some of the rules relating to the development of an area or a particular site. It contains information on the zoning of land and any special provisions relating to the development of the land. An LEP is enforceable after it is published in the Government Gazette (i.e. "gazetted") by the NSW Minister for Planning. Typically, LEPs and REPs have provisions that protect items of environmental heritage.

There are three LEPs which affect this stage of the project:

a) Wagga Wagga Local Environment Plan
b) Junee Local Environment Plan
c) Cootamundra Local Environment Plan

9.3.1 Wagga Wagga Local Environmental Plan 1985

The *Wagga Wagga Local Environmental Plan 1985* (WWLEP) is the statutory (legal) planning document that applies to the City of Wagga Wagga.

The WWLEP requires a development consent where a proposed development is likely to impact items of environmental heritage (Clause 16) or specifically within a conservation area (Clause 17). Items of environmental heritage includes evidence of Aboriginal or historic occupation prior to 1 January 1900. Clause 18 allows Council to approve certain impacts to items of environmental heritage or buildings within conservation areas provided the Council is satisfied that "the use would have little or no adverse effect on the amenity of the neighbourhood".

The WWLEP does not list a schedule of items of environmental heritage or conservation areas.

9.3.2 Wagga Wagga Rural Local Environmental Plan 1991

The *Wagga Wagga Rural Local Environmental Plan 1991* (WWRLEP) is the statutory (legal) planning document that applies to the whole of the Wagga Wagga LGA outside the boundaries of the City of Wagga Wagga.

The WWRLEP requires a development consent where a proposed development is likely to impact items of environmental heritage (Clause 24(1)). Council may provide consent after it has made an assessment of an item's significance, the impacts on that significance Including the setting of the item) and whether the item poses a danger to users/occupiers or the public (Clause 24(2)).

Should development occur within the vicinity of the land on which an item of environmental heritage item is situated, Council must assess the effect which the carrying out of that development will have on the historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance of the item of the environmental heritage and its settings (Clause 25).

The Council shall not grant consent to a development application to carry out development in the vicinity of the land on which an item of the environmental heritage is situated unless the Council has made an assessment of

The WWLEP does not list a schedule of items of environmental heritage.

9.3.3 Draft Wagga Wagga Local Environmental Plan 2008

The draft *Wagga Wagga Local Environmental Plan 2008* (draft WWLEP) was placed on public exhibition in ??? It is intended to replace the existing WWLEP. While it is not currently in force, the draft WWLEP should be taken into account when identifying legal constraints to development.

The draft WWLEP requires a development consent where a proposed development is likely to impact heritage items, heritage conservation areas and archaeological sites (Clause 5.10). Heritage items include Aboriginal objects that are listed in the LEP. Under the draft WWLEP and archaeological site only relates to items of historic heritage. Clause 5.10 allows Council to approve certain impacts to items of environmental heritage or buildings within conservation areas following assessment of effects on heritage significance..

Items of environmental heritage and conservation areas are listed in Schedule 5 of the draft WWLEP.

9.3.4 Junee Local Environmental Plan 1992

The *Junee Local Environmental Plan 1992* (JLEP) is the statutory (legal) planning document that applies to the whole of the Junee LGA.

The JLEP requires a development consent where a proposed development is likely to impact heritage items (Clause 29(1)). Council may provide consent after it has made an assessment of the affect a development may have on an item's significance, and any stylistic or horticultural features and its setting (Clause 29(2)). Council may also require Conservation Plan to accompany a development application so as to adequately assess impacts on a heritage item (Clause 29 (3)). The Council must also assess the affect a development on land in the vicinity of a heritage item will have on the heritage significance of the item and its setting (Clause 30).

Clause 31 provides similar, and more specific requirements, regarding development in a heritage conservation area.

Items of State and local heritage significance are listed in Schedule 1 of the JLEP.

10.0 Mitigation and Management of Aboriginal Cultural Heritage Values

This section provides a strategy for managing the Aboriginal heritage values of the study area.

The findings of this assessment can be summarised as:

- a review of the AHIMS database administered by DECCW suggest there are 13 previously recorded Aboriginal sites within the impact zone of the pipeline easement. Some of these sites are recorded twice, providing updated and augmented information;
- a total of 36 Aboriginal sites including most of the AHIMS sites were identified during the field survey all of which consisted of stone artefact sites. Of these, 27 were low-density artefact scatters (including an artefact scatter adjacent to *possible* Aboriginal water holes), and six were isolated finds. A total of 29 of these sites will be impacted by pipeline construction;
- alternative routes are not possible to avoid these sites as the new pipe must be laid within the pipeline easement;
- there are no indications at present that there are significant Aboriginal heritage values that would be affected by the development. Sites which will be impacted have already been subject to substantial disturbance associated with the initial pipeline construction; and
- on the basis of this assessment, it is considered the proposed development will encounter surface and possibly subsurface Aboriginal objects.

10.1 Mitigation and Management Options

The management options discussed in this section are presented to inform a management strategy that recognises the Aboriginal cultural heritage values of sites within pipeline easement. The management strategy outlined in **Section 11.0** is based on the assessed heritage significance of the study area as outlined in the Burra Charter.

The range of options potentially available is presented below. Each option is discussed and will be applied to individual sites in **Section 11.0**. **Section 8.0** shows that the new pipeline construction will impact a total of 19 sites.

10.1.1 Unmitigated Destruction

One option is to destroy any known Aboriginal sites or objects. This strategy is typically suitable when the heritage values are of low scientific significance, the relevant Aboriginal stakeholders have no objection, and/or other strategies are not feasible. The sites in the study area are heavily disturbed and out of context, and are regarded as having low scientific value (**Section 8.0**).

10.1.2 Mitigated Destruction (Salvage)

Another option is to destroy Aboriginal sites following collection of surface artefacts and/or systematic excavation of deposits.

This option is usually considered where:

- sites are assessed as having moderate or high significance;
- sites have potential to yield information that is not available from other sources; and
- the potential for conservation is limited.

Aboriginal stakeholders tend to regard all Aboriginal sites as being culturally significant, making this option the minimum acceptable strategy.

10.1.3 Site Conservation

This option refers to the conservation of all or a selected number (representative sample) of Aboriginal sites within the study area. This may be achieved through either:

- in situ management of sites, e.g. retention of sites within their current context with appropriate management measures implemented, which may include fencing and/or suitable signage; and/or
- the creation of appropriate conservation areas as offsets for the loss of medium to highly significant archaeological and Aboriginal cultural heritage sites and values within the study area.

The in situ management strategy is effective for sites that occur in areas that will not be impacted by ground disturbance. The conservation area strategy is suitable where sufficiently large enough areas of land are available to conserve a representative sample of both site and terrain unit types.

Conservation is not a realistic option for this project, as the construction must take place within the pipeline easement, and diversions of the pipeline are not possible within this constraint.

10.1.4 Monitoring

This option is usually taken to mean the observation of initial ground surface disturbance during the early stages of a development to monitor for potential artefact deposits, including the presence of human skeletal remains.

Monitoring is often recommended as a management strategy by Aboriginal stakeholders. However, there is little data to suggest that this strategy is effective in conserving artefact deposits. Furthermore, construction companies are reluctant to allow monitoring on safety grounds.

Monitoring may be a feasible option for sites APA 20 and APA 36 due to their potential significance to the Aboriginal community.

11.0 Management Commitments

The following heritage management commitments are made regarding the project. These are made on the basis of:

- the findings of the field survey and previous work done in the study area;
- the assessed heritage significance of the archaeological sites;
- the stated interests of the Aboriginal community; and
- the likely impacts resulting from the various components of the proposed development.

The heritage management commitments are provided in two levels:

- general commitments that are applicable to all sites and the study area as a whole (**Section 11.1**); and
- specific commitments for Aboriginal sites (**Section 11.2**).

11.1 General Heritage Management Commitments

The following general heritage management commitments are made:

- All standing structures (buildings) will be avoided by the pipeline construction footprint.
- Should Aboriginal skeletal material be encountered during the excavation process, then work will cease at that location and the procedures identified in **Section 11.2.1** will be implemented.
- Construction crews will be made aware of the potential for cultural heritage items to occur outside the study area (easement). Ground impacts outside the easement, particularly within 50 m of watercourses will be avoided. Training and induction will be provided and reinforced during regular toolbox talks.

11.2 Aboriginal Heritage Management Commitments

Table 18 details management requirements for Aboriginal sites identified in the study area. This includes the ultimate impact and management requirements for each site.

Table 18: Management Commitments for Aboriginal Heritage Sites within the Study Area

Site ID	AHIMS No.	Within Study Area?	Final Impact?	Final Management Requirement
APA 1		Yes	Yes	Destroy without salvage.
APA 2		Yes	Yes	Destroy without salvage.
APA 3		Yes	Yes	Destroy without salvage.
APA 4	50-5-0082	Yes	Partial	Site is only partially impacted where transect runs through it. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location.
APA 5	50-5-0005	Yes	Yes	Site has been previously excavated. Artefacts encountered are heavily disturbed. Destroy without salvage.
APA 6	50-5-0004; 50-5-0078;	Yes	Yes	Destroy without salvage.
APA 7		No	No	Outside study area. No Management required.
APA 8		Yes	Yes	Destroy without salvage.
APA 9	50-5-0079	Yes	Yes	Destroy without salvage.
APA 10		No	No	Outside study area. No Management required.

Site ID	AHIMS No.	Within Study Area?	Final Impact?	Final Management Requirement
APA 11		Yes	Yes	Destroy without salvage.
APA 12	50-5-0008	Yes	Partial	Site is far more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 13		Yes	Yes	Destroy without salvage.
APA 14	50-5-0080	Yes	Partial	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 15		No	No	Outside study area. No Management required.
APA 16		No	No	Outside study area. No Management required.
APA 17		No	No	Outside study area. No Management required.
APA 18		Yes	Yes	Destroy without salvage.
APA 19		Yes	Yes	Destroy without salvage.
APA 20	50-5-0003; 50-5-0083	Yes	Partial	Pipeline easement passes through area of possible cultural significance, but has already been extensively disturbed by previous pipeline and fibre optic cable construction. The water holes should be fenced off to further mitigate against impact. This creek should be under-bored rather than blasted and/or trenched.
APA 21		No	No	Outside study area. No Management required.
APA 22	50-5-0009	Yes	Partial	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 23		Yes	Yes	Destroy without salvage.
APA 24	50-5-0009	Yes	Yes	Destroy without salvage.
APA 25		Yes	Yes	Destroy without salvage.
APA 26		Yes	Yes	Destroy without salvage.
APA 27		Yes	Partial	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location

Site ID	AHIMS No.	Within Study Area?	Final Impact?	Final Management Requirement
APA 28		Yes	Partial	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 29	56-2-0001	Yes	Partial	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Site was subject to surface salvage in 1980. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 30		No	No	Outside study area. No Management required.
APA 31		Yes	Yes	Destroy without salvage.
APA 32		Yes	Yes	Destroy without salvage.
APA 33		Yes	Yes	Destroy without salvage.
APA 34		Yes	Yes	Destroy without salvage.
APA 35		Yes	Yes	Destroy without salvage.
APA 36		Yes	Yes	Site has been identified as being of possible cultural significance by Aboriginal stakeholders based on its outlook. The new pipeline trench should converge as close as possible to the existing pipeline to minimise any spread of impacts.

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11.2.1 Procedure on Discovery of Human Remains

This section outlines the procedures to be undertaken in the case that human remains are discovered during development. The procedures take into account the following documents:

- *Manual for the Identification of Aboriginal Remains* (DEC 2005);
- *Skeletal Remains – Guidelines for the management of human skeletal remains under the Heritage Act 1977* (NSW Heritage Office 1998); and
- The *Aboriginal Cultural Heritage Standards and Guidelines Kit* (NPWS 1997).

In the event that construction activity reveals possible human skeletal material (remains) along the alignment, the following procedure is to be followed:

1) When suspected human remains are exposed, all construction work is to cease immediately in the near vicinity of the find location and the Construction Manager on site is to be immediately notified to allow assessment and management;

3) An area of 5 m radius is to be cordoned off by temporary fencing around the exposed human remains site - construction work can continue outside of this area as long as there is no risk of interference to the human remains or the assessment of human remains;

4) The Construction Manager on site is to notify the proponent;

5) The Police are to be contacted at the earliest reasonable time;

6) Contact DECCW's Environment line on 131 555 and the Heritage Office on (02) 9873 8500; and

7) A physical or forensic anthropologist should be commissioned by the land manager to inspect the remains in situ (organised by the police unless otherwise directed by the police), and make a determination of ancestry (Aboriginal or non-Aboriginal) and antiquity (pre-contact, historic or modern):
   - i) if the remains are identified as modern the area is deemed as crime scene; or
   - ii) if the remains are identified as Aboriginal, the site is to be secured and DECCW and all Aboriginal stakeholders are to be notified in writing; or
   - iii) if the remains are identified as non-Aboriginal (historical) remains, the site is to be secured and the Heritage Office is to be contacted.

The above process functions only to appropriately identify the remains and secure the site. From this time, the management of the area and remains is to be determined through one of the following means:

- i) if the remains are identified as a modern matter liaise with the police;
- iv) if the remains are identified as Aboriginal liaise with the proponent, the DoP, the DECCW and Aboriginal stakeholders;
- v) if the remains are identified as non-Aboriginal (historical) liaise with the proponent, the DoP (Heritage Branch);
- vi) if the remains are identified as not being human then work can recommence without delay.

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Tables

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Table T1: Survey Transects and effective coverage

Transect No	Point	MGA Easting	MGA Northing	Landforms	Description	Area (m^2)	Visibility (%)	Effective Coverage (m^2)	Effective Coverage (%)
T1	Start Finish	576973 579099	6153300 6154421	Terrace/flats, creek	This transect covers gently undulating cropland and the headwaters of a 1st order creek line. No artefacts were found.	5920	20	118.4	2
T2	Start Finish	579263 581656	6154536 6156088	Hillside, ridge top, creek, gentle slope	This transect covered the edges of a hilly pass in the Bethungra Range, skirting around the south eastern extent of Bethungra Mountain. It begins on gently rising pasture before moving through hillier country on the edge of the Bethungra Range. The transect begins at an elevation of 300 m and ascends to a height of 420 m at its termination. Sites APA 1 and APA 2 were located on this transect.	228800	60	13728	6
T3	Start Finish	582522 582077	6158268 6157683	Hillside, gentle slope, creek, flats	This transect covered ground from the west of Bethungra township across to an area to the northeast of the town. The transect commences at the side of Old Sydney Road and runs along gently undulating pasture and crosses two roadways before travelling along flats associated with Ulandra Creek. After crossing Ulandra creek the transect continues along flats until the foothills of the Bethungra Range are reached, and the topography generally becomes steeper. Transect terminates on a spur crest in a lightly pastured area.	192800	40	7712	4
T4	Start Finish	571337 571018	6147960 6147751	Ridgeline, gentle slope, creek terrace/flats	This transect is associated with the eastern channel of Billabung Creek, and starts in large concentration of broken river cobbles on low ridgeline overlooking the creek to the east. The cobbles become more sparsely concentrated as the transect moves downslope to the creek. The creek is approximately 5 m wide in the channel and has a narrow terrace on the western side where the pipeline crosses. Creek banks are relatively steep and eroded. The transect finishes in a paddock at the edge of cropped area, travelling through a previously excavated site on the edge of the creek flats. Previously recorded AHIMS sites 50-5-0005 and 50-5-0082 are within this transect. Site APA4 identified in this transect.	45816	15	687.24	1.5

Transect No	Point	MGA Easting	MGA Northing	Landforms	Description	Area (m^2)	Visibility (%)	Effective Coverage (m^2)	Effective Coverage (%)
T5	Start Finish	570377 570172	6147243 6147173	Creek bank, creek flats, pasture	This transect is associated with the western channel of Billabung Creek, and starts on creek flats in low pasture up to 200 mm high on creek flats with 10-20% visibility adjacent to fenceline with crops on the eastern side. Transect continues south east crossing the creek channel, which is approximateley 10 m wide in the creek bed with gently to moderately sloping creek banks. Transect terminated at the edge of cropland on the western side of the creek channel, where the land slopes gently upwards towards a very low ridgeline. 0% visibility through crops. Previously recorded AHIMS sites 50-5-0004 and 50-5-0078 are within this transect. AHIMS site 50-5-0079 lies approximately 40 m north west of the transect extent and was not revisited due to crop cover. Sites APA 5 and APA 6 identified in this transect.	25896	15	388.44	1.5
T6	Start Finish	561285 561484	6139740 6139904	eroded stream bank/ ridgeline, hillside	This transect is associated with an un-named 1st order creek and commences across a low ridgeline proceeding in a northeasterly direction towards the creek. The transect traverses a gently falling slope with 40% visibility amongst the low-growth pasture. The pipeline passes just to the north of a dam in the creek line. The transect terminates on a contour bank that runs north-south amongst the crops, on north bank of drainage line in cropland affording 40% visibility. Sites APA 7, APA8 and APA 9 identified in this transect.	31080	40	1243.2	4
T7	Start Finish	561055 560877	6139659 6139438	gentle slope	Transect heads south southwest along a gentle slope dropping towards a shallow 2nd order drainage. The drainiage is a shallow meandering channel with gently to moderately sloping banks. Low pasture through transect to 100 mm, visibility.	34116	5	170.58	0.5

Transect No	Point	MGA Easting	MGA Northing	Landforms	Description	Area (m^2)	Visibility (%)	Effective Coverage (m^2)	Effective Coverage (%)
T8	Start Finish	559776 559428	6138774 6138434	gentle slope/cropland	Commencing at Oades Lane in a southwesterly direction across a small rise off a spur escaprment following pipeline easement. Quartz fragments are scattered along pipeline from a point 20m from Oades Lane to a mid-field gas marker. Five quartz and quartzite artefacts recorded (part of site 50-5-0008). Transect continues through open pasture up to 100 mm high, with many exposures with up to 40% visibility present. Transect terminates at edge of wheat field through which access could not be obtained and visibility was zero. Three quartz artefacts and a slate scraper were recorded along a fenced laneway adjacent to the wheat field. Wanitool Creek was a further 100m through the crop and was inspected by one person. Zero artefacts observed with visibility very poor at less than 5% and few exposures.	58368	4	233.472	0.4
T9	Start Finish	559067 558749	6138069 6137754	Spurline, ridge crest	Gently rising spurline to a low ridge crest commencing on Junee-Eurongilly road across from pipeline valve and heading south southwest. Transect runs through previously recorded site 50-5-80 of 260x50m extent. 27 predominately quartz artefacts in total recorded in transect with one chert flake. Transect terminates on fenced reserve corridor at pipeline chainage 102km (from Young).	57792	15	866.88	1.5

Transect No	Point	MGA Easting	MGA Northing	Landforms	Description	Area (m^2)	Visibility (%)	Effective Coverage (m^2)	Effective Coverage (%)
T10	Start Finish	556711 557332	6135774 6136335	Hillside, ridgeline with rock outcrops	Transect commences at line valve site at chainage 105km (From Young), proceeding east northeasterly along a 1st order drainage depression (dd1)approx 6m wide and varying from 0.5 to 0.8m deep. The drainage line has moderately sloped banks and is mostly cleared with areas of exposure except for middle of channel which is covered in pasture and has visibility of less than 10%. The drainage line is dammed at 200m from the commencement of the transect (APA 9). The transect crosses a paddock to another first order drainage (dd2) before ascending a hillside to a ridgeline at pipleine chainage 104km. The transect proceeds from the exposures in the creek bed dd2 at APA 11 in a northeasterly direction up a hillside which had several exposed rocky outcrops to a spur line at pipeline chainage 104km. Nil artefacts were recorded on the hillside however numerous pieces of quartz gravel and some cobbles were noted.	102672	8	821.376	0.8
T11	Start Finish	554359 554030	6133831 6133609	Hillside, Ridge Crest,	The transect commences at pipeline chainage 108km proceeding southwest towards previously recorded site 50-5-3 and continuing on to the second creekline. Second drainage line 10m wide by 2m deep at southwest end of transect. 1st order drainage with moderately sloping banks with erosion and several exposed contour banks. Visibility 40% in exposed areas and 20% in pasture areas. Total exposure c2500m2. eight quartz flakes and flaked pieces evident in an area 50x20m straddling both sides of creekline and up to 10m either side. Transect terminates on edge of second drainage line.	47592	20	951.84	2

Transect No	Point	MGA Easting	MGA Northing	Landforms	Description	Area (m^2)	Visibility (%)	Effective Coverage (m^2)	Effective Coverage (%)
T12	Start Finish	553354 552885	6132984 6132307	Ridge Crest	Transect starts at pipeline marker 109.3 moving southeast through headwaters of 1st order drainage depression. The headwaters run into an eroded drainage channel which is well outside the pipeline easement. No defined channel present in the easement. Granite outcrops present on slopes and ridgecrests. Granite and Quartz pebbles and gravel evident throughout valley. Transect terminates on a ridge featuring granite outcrops with good outlook. No artefacts were recorded in this transect. Exposures included cattle tracks and drainage lines in open pasture. Visibility 60% with 40% of transect exposed.	67400	40	2696	4
T13	Start Finish	551199 551627	6130459 6131060	Spur line, Creek bed	Transect commences on a spur line proceeding southwest towards Bucks creek and previously recorded site 50-5-9. Nil artefacts recorded down ridge slope, which was covered by low pasture with visibility at 10%. A recently ploughed field offering good visibility yielded 5 quartz artefacts including three flaked pieces, a core and a flake. Transect terminates at the edge of the ploughed field containing APA 14.	96048	10	960.48	1
T14	Start Finish	549050 549437	6128401 6128761	Creek Flats	Transect commences from a point west of Pattersons Lane heading in a northerly direction.	53030	8	424.24	0.8
T15	Start Finish	546072 547044	6125662 6126548	Flat, Low ridge, Creek channel, hillside, ridgeline	Transect commences off Holloways road on its north side, proceeding in a north easterly direction. Low level pasture with some evidence of ploughing, evidence of sheep grazing. The transect crosses two 1st order drainage depressions, both of which have very shallow channels about 0.2 m deep and 1 m wide, and visibility of less than 10%. Completion of transect from intermediate point above. Crosses over spur crest and down the other side of the hill. Land is cleared with pasture to 300 mm high and 10% visibility. Exposures from cattle tracks, tree shadows and around gas pipe sign.	132000	8	1056	0.8

Transect No	Point	MGA Easting	MGA Northing	Landforms	Description	Area (m^2)	Visibility (%)	Effective Coverage (m^2)	Effective Coverage (%)
T16	Start Finish	543984 544221	6123894 6124101	Spur crest, ridgeline,	Moderately steep spur crest. Low pasture with 20% visibility. Many quartz gravel/cobbles scattered all the way down the spur crest/slopes from the water tank at the crest down to the fence. Many large quartz gravel/cobbles scattered all the way down the spur crest/slopes from the water tank at the crest down to the fence. Transect terminates on the northern side of the crest at a fenceline, just to the north of a large hilltop water tank. The paddock opposite the fence contains wheat crop and is impassable and had zero visibility.	44044	20	880.88	2
T17	Start Finish	545615 544715	6125222 6124495	Hillside, flat, Ridge Crest	Transect commences in gently undulating pasture and with low rises and depressions. Pasture offers less than 10% visibility.	162400	8	1299.2	0.8
T18	Start Finish	540003 539275	6120765 6120017	Ridge top. Lower Slope, Mid Slope, Upper Slope, Gently sloping plain, Rocky outcrop.	Transect begins at the low end of a hillside in paddocks belonging to Buckmans Chemicals. It travels over undulating pasture to climb a large hilltop featuring granite boulder outcrops and a vast outlook. Minor quartz cobbles occur on the northeast slope. Pastural crop to 200 mm high with ploughed furrows. Visibility less than 10%. Scatter of artefacts on crest of hill with heavy granite boulder outcropping. A series of small exposures less than 1m2 includes three quartz cores and five quartz flaked pieces, most of which is attributable to debitage. Site identified by Ramsay Freeman as being of probable cultural significance. Transect finishes on the south side of a gently sloping hill, in heavily cropped pasture approx 150 mm high. Nil artefacts recorded between APA27 and the end of the transect. Limited areas of ground exposure with low visibility.	147000	8	1176	0.8

Table T2: Aboriginal Sites located during the survey

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 1	Centroid			Site accessed from the property "Emmaville". Take the property access off the Olympic way about 1km north of Bethungra and travel past the homestead and outbuildings and take the right hand track which skirts a dam. Pipeline easement is located adjacent to a large spreading tree on the other side of a fenceline. Head along pipeline easement in an ENE direction	Artefact Scatter	Undulating plain, Plain	This site consists of a scatter of nine artefacts made from various types of raw material. Present were four flakes made of black volcanic material as well as a silcrete flake and several pieces of quartz. It was located in an exposure approximately 50x10m.	Destroy without salvage.
APA 2	Centroid			Site accessed from the property "Emmaville". Take the property access off the Olympic way about 1km north of Bethungra and travel past the homestead and outbuildings and take the right hand track which skirts a dam. Pipeline easement is located adjacent to a large spreading tree on the other side of a fenceline. Site is located approx 20m from the pipeline marker 75-9 in an easterly direction along the pipeline easement.	Artefact Scatter	Undulating plain, Mid slope	This site consists of two flaked pieces located in a 20x20m exposure next to a large tree. The artefacts are located either side of the pipe trench from the original pipe.	Destroy without salvage.
APA 3	Centroid			Site was accessed via the property "Emmaville". Enter the pipeline easement directly from the road and continue along the easement on the level until it begins to ascent a spur line. Site is located approximately halfway up the spur on the southeastern side of the pipeline easement.	Artefact Scatter	Rolling hills, Mid slope	This site consists of two flaked pieces located in erosion associated with vehicle tracks which run along the pipeline easement. It is on a gently sloping spur crest facing south west. Vegetation consists of low pasture up to 100mm with visiblility at 20%, site is located in a 10x2m area	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 4	Centroid			Accessed via property "Carinya" off the Olympic Way, approximately 9 km south east of Bethungra.	Artefact Scatter	Rolling hills, Lower slope	Originally recorded as an isolated find adjacent to the east bank of Billabung Creek by Witter (1980). The site was re-recorded by Kelton (2006) as a possible quarry site for Pleistocene alluvial gravel procurement measuring some 700 m in length up a gentle slope, ending at gas marker "85.3". This survey identified two artefacts in close proximity to Witter's original record. The site consists of one quartz flake and one grinding dish 10 m apart on a bare erth track on the east side of the creek's boundary fence, and approximately 10 m south of the current pipeline alignment.	Site is only partially impacted where transect runs through it. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location.
APA 5	Centroid			Accessed via property "Carinya" off the Olympic Way, approximately 9 km south east of Bethungra. Site is on the western side of the creek channel.	Artefact Scatter	Rolling hills, Stream bank, Terrace Flat	This site was previously recorded by Witter (1980) and subsequently excavated by Kelly (1980). Theis survey identified a scatter of quartz, quartzite, slate and silcrete flakes and flaked pieces as well as a possible grinding stone in exposures resulting from cattle pads and vehicle tracks. A total of 22 artefacts were recorded in a 100 x 100 area centred over the pipeline easement. The areas has been extensively disturbed by ploughing, pipe construction and excavation.	Site has been previously excavated. Artefacts encountered are heavily disturbed. Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 6	Centroid			Accessed via property "Avoca". Site is located along the pipeline route commencing at the E-W fence line, at the gas marker, and following the pipeline easement SE towards the creek. Contour bank crosses in front of a farm gate in the pipeline easement.	Artefact Scatter	Rolling hills, Stream bank, Terrace Flat	This site is probably an extension of the sites originally recorded by Witter (50-5-0004) and Kelton (50-5-0078), although it is on the opposite side of Billabung Creek (eastern side) and marginally more than 50 m away. This survey identified A total of 10 quartz flaked pieces and one silcrete flaked piece on a contour bank on the alluvial terrace flat. Site area approx 20 x 6 m with 80% visibility.	Destroy without salvage.
APA 7	Centroid			Accessed via property "Avoca". Site is located along the pipeline route commencing at the E-W fence line, at the gas marker, and following the pipeline easement SE towards the creek. Cross the creek to the large exposure on the western side.	Artefact Scatter	Rolling hills, Lower slope, Stream bank	Eroding creek bank on western side of Billabung Creek (Western Branch). Previously recorded by Witter (50-5-0004) as an 80 x 20 m exposure with one tool, two cores and 27 pieces of flaked debitage. This survey identified a total 21 artefacts in an area of 60 x 20 m, some of which were not conclusively diagnostic. The hammerstone identified by Witter (1980) was not re-identified. Kelton (50-5-0078) identified 2-4 artefacts about 35 m north of the pipeline route (outside the easement).	Outside study area. No Management required.
APA 8	Centroid			Drive SE from Junee on Junee-Eurongilly Road for about 8 km and turn left onto Hazeldene Road. Follow road around to the north and take the left road when the road forks to the east. Continue north. Accessed from the property "Lynton", via farm gate on the eastern side of the road about 500 m south of the house.	Artefact Scatter	Rolling hills, Lower slope	This site is an artefact scatter on contour bank used to drain water off the hillside into the dam within a 1st order drainage line. Three quartz flaked pieces identified in an area 20 x 3 m (although possibly extending further). The contour bank is on the eastern side of the drainage line on a lower slope and was amongst crops during the survey.	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 9	Centroid			Accessed via property "Avoca". Site is located along the pipeline route commencing at the E-W fence line, at the gas marker, and following the pipeline easement SE towards the creek.	Artefact Scatter	Rolling hills	This site is part of site 50-5-0079 recorded by Kelton (2006). Kelton's site card suggests that the site runs the extent of the terrace between the two branches of Billabung Creek, although he only recorded two artefacts. This recording identified a further three artefacts in a 75 x 25 m area between an internal property fence and the west branch of the creek. Visibility in the low pasture of the paddock was approx. 40%. The site card for 50-5-0079 indicates that some auger test excavations were carried out.	Destroy without salvage.
APA 10	Artefact			Drive SE from Junee on Junee-Eurongilly Road for about 8 km and turn left onto Hazeldene Road. Follow road around to the north and take the left road when the road forks to the east. Continue north. Accessed from the property "Lynton", via farm gate on the eastern side of the road about 500 m south of the house.	Isolated Find	Rolling hills, Mid slope	This site consists of an isolated silcrete flake in an exposed vehicle track adjacent to fenceline, approximately 100 m east of a contour bank on the east side of a 1st order drainage depression. The site is outside the impact area of pipeline works.	Outside study area. No Management required.
APA 11	Centroid			Drive SE from Junee on Junee-Eurongilly Road for about 8 km and turn left onto Hazeldene Road. Follow road around to the north and take the left road when the road forks to the east. Continue north. Accessed from the property "Lynton", via farm gate on the eastern side of the road about 500 m south of the house.	Artefact Scatter	Rolling hills, Flat	This site consists of a small scatter of four quartz artefacts in a 10 x 10 m area, within a 20 x 20 m exposure with 70% visibility. The exposure is located on the existing pipeline route approximately 50 m east of a dam.	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 12	Centroid			Accessed via Oades Lane at the gas marker crossing. Cross the fence on the southern side of the road. Site extends 130 m SE from the fence.	Artefact Scatter	Rolling hills, Upper slope	This site was recorded by Witter (1980) consisting of a large, low density scatter of 13 flakes over an area of 540 x 120 m from Oades Lane down a NW-SE facing spur crest. The pipeline crosses this site near Oades Lane. This survey 6 artefacts along the spur line (within Witters original site area) and a further 7 artefacts along the pipeline easement in an area of 130 x 20 m extending from Oades Lane to a point approximately 20 m SE of a mid-slope gas marker. The site consists of quartz and quartzite flakes and flaked pieces. The upper slope is littered with numerous quartz and quartzite gravel and cobbles, many of which demonstrate shatter attributes.	Site is far more extensive than the easement. Only a small percentage which has already been disturbed will be redisturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 13	Centroid			Accessed via Oades Lane at the gas marker crossing. Cross the fence on the southern side of the road. Walk SE along pipeline easement for approximately 350 m. Site commences 15 m NE of a dam and follows pipeline easement.	Artefact Scatter	Rolling hills, Lower slope	This site consists of two quartz artefacts recorded consisting of one quartz flake and one quartz flake with evidence of backing. The site covers a 100 x 20 m area commencing 15 m NE of a dam and finishing within a fenced laneway to the north of Wantiool Creek. The site is in the vicinity of existing site 50-5-0008, but further downslope within the pipeline easement. The slope is covered in low pasture with 40% visibility.	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 14	Centroid			Drive SE from Junee along Junee-Eurongilly Road. After approximately 7 km there is a gas line-valve on the northern side of the road. Access the site on the southern side of the road via two farm gates approximately 50 m east of the pipeline road crossing.	Artefact Scatter	Rolling hills, Lower slope	This site was original recorded by Kelton (2006) as a 10 x 2 m area consisting of 3 artefacts including a hammerstone/manuport. This survey identified a total of 27 flakes, flaked pieces and cores made from mostly quartz and one instance of chert. The site area occupies an area of some 260 x 50 m extending SE from the Junee-Eurongilly Road to Witter/Kelton's original recording. The area has been highly disturbed by cultivation and previous trenching from pipeline and optical fibre cable construction.	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 15	Artefact			Travel SE from Junee along Junee-Eurongilly Road for about 3 km then turn south along Burnt Creek Lane. Follow Burnt Creek lane south until just before it turns sharply west. On the east side of the road is a gas line valve station and the entrance to the property "Wirrega". Enter the property and immediately turn left (north) along the fence line. The site is approximately 20 m north of the gate before crossing the drainage depression.	Isolated Find	Rolling hills, Flat	This site consists of large pointed slate flake with possible retouch on one edge found on western edge of farm track just inside gate on south side of drainage depression, approx 2 m from edge. The site is outside the pipeline easement.	Outside study area. No Management required.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 16	Centroid			Travel SE from Junee along Junee-Eurongilly Road for about 3 km then turn south along Burnt Creek Lane. Follow Burnt Creek lane south until just before it turns sharply west. On the east side of the road is a gas line valve station and the entrance to the property "Wirrega". Enter the property and immediately turn left (north) along the fence line. Park and follow the drainage depression eastwards to the dam. The site is within the dam enclosure on the southern side. At the time of the survey, the dam was mostly empty.	Artefact Scatter	Undulating plain, Stream bank, Stream channel	this site is located within a dam on a 1 st order drainage depression with areas of exposure on dam bed and entrance channel. The dam straddles the drainage depression. At the time of the survey, the paddocks either side of the drainage line had wheat crops with zero visibility. The site is approx 20 x 3 m in extent within an exposure of 60 x 3 m. Seven quartz and quartzite flakes were recorded amonst a scatter of slate gravel material. The site is within the dam enclosure on the southern side. At the time of the survey, the dam was mostly empty. The site is outside the pipeline easement and will not be affected by construction.	Outside study area. No Management required.
APA 17	Centroid			Travel SE from Junee along Junee-Eurongilly Road for about 3 km then turn south along Burnt Creek Lane. Follow Burnt Creek lane south until just before it turns sharply west. On the east side of the road is a gas line valve station and the entrance to the property "Wirrega". Enter the property and immediately turn left (north) along the fence line. Park and follow the drainage depression eastwards to a dam on the creek. Continue beyond the dam to within 10 m of the fence crossing the creek.	Artefact Scatter	Rolling hills, Stream bank, Stream channel	This site is a small stone artefact scatter measuring 5 x 1 m in an exposure measuring 20 x 3 m on the southern bank of a 1st order drainage depression, approx 10 m west of a paddock fenceline. Visibility in the exposure was 90%. A total of four quartz artefacts were recorded. The site is outside the pipeline easement and will not be affected by construction.	Outside study area. No Management required.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 18	Centroid			Travel SE from Junee along Junee-Eurongilly Road for about 3 km then turn south along Burnt Creek Lane. Follow Burnt Creek lane south until just before it turns sharply west. On the east side of the road is a gas line valve station and the entrance to the property "Wirrega". Enter the property and immediately turn left (north) along the fence line. Park and follow the drainage depression eastwards to a dam on the creek. Continue beyond the dam to the fence crossing the creek and follow a track north through another fence to a second drainage depression. The site is located inand around the dam.	Artefact Scatter	Rolling hills, Stream bank, Stream channel	This site consists of small clusters of quartz artefacts on both sides of a 1st order drainage line in and around a dam straddling the creek. The site is in in areas of exposure from within the dam enclosure to 20 m downstream of the dam. Exposure 1 containes seven quartz and slate artefacts in an area 4 x 50 m within and adjacent to the dam. Exposure 2 is located on a contour bank on the north side of the drainage and measures 3 x 60 m. It contains two clusters of artefacts each containing two quartz flakes.	Destroy without salvage.
APA 19	Centroid			Accessed via property "Baltimore". Travel SE from Junee along Junee-Eurongilly Road for about 3 km then turn south along Burnt Creek Lane. Follow Burnt Creek lane south until it turns west then south again. Continue on as far as the road can go. Enter property through a gate about 50 m from the end of the road and follow farm track along fenceline, then across the paddock in a south easterly direction through another gate until you meet the gas pipeline on top of a ridge line at gas marker "108". Follow the pipeline downslope to a mid-slope contour bank with a gas marker. The site is appoximately 10 m SE of the eastern end of the bank.	Artefact Scatter	Rolling hills, Mid slope	This site consists of three quartz artefacts in a 6 x 1 m site area within an S-shaped exposure measuring 50 x 5 m. The exposure is approximately 10m SE of a contour bank with a gas marker post. Visibility within the exposure was 40%. The site is approximately 90 m upslope to the north of existing site 50-5-0003/50-5-0083.	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 20	Centroid			Accessed via property "Baltimore". Travel SE from Junee along Junee-Eurongilly Road for about 3 km then turn south along Burnt Creek Lane. Follow Burnt Creek lane south until it turns west then south again. Continue on as far as the road can go. Enter property through a gate about 50 m from the end of the road and follow farm track along fenceline, then across the paddock in a south easterly direction through another gate until you meet the gas pipeline on top of a ridge line at gas marker "108". Follow the pipeline downslope to the SE to the first creek crossing. Site is located here at gas marker "108.2".	Artefact Scatter	Rolling hills, Lower slope, Stream bank, Stream Channel	This site was originally recorded by Witter (50-5-0003) and re-recorded by Kelton (50-5-0083). Witter identified what are possibly Aboriginal waterholes in an area of granite bedrock in the bed of a creek. The site also identified several quartz fragments amongst granite boulders on the lower slopes above the creek, but nor with definite flaking attributes. The western edge of the granite platform has been blasted during construction of the previous pipeline. This survey identified a single quartz flake on the northern side of the creek bed.	Pipeline easement passes through area of possible cultural significance, but has already been extensively disturbed by previous pipeline and fibre optic cable construction. The water holes should be fenced off to further mitigate against impact. This creek should be under-bored rather than blasted and/or trenched.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 21	Centroid			Accessed via property "Baltimore". Travel SE from Junee along Junee-Eurongilly Road for about 3 km then turn south along Burnt Creek Lane. Follow Burnt Creek lane south until it turns west then south again. Continue on as far as the road can go. Enter property through a gate about 50 m from the end of the road and follow farm track along fenceline, then across the paddock in a south easterly direction through another gate until you meet the gas pipeline on top of a ridge line at gas marker "108". Follow the pipeline downslope tand cross a drainage line with a granite bedrock platform (Site 50-5-0003) and continue SE for 160 m to a second drainage line. The site is on the north side of an E-W fenceline.	Artefact Scatter	Rolling hills, Lower slope, Stream bank	This site consists of 8 quartz flakes and flaked pieces in an area measuring 50 x 20 m straddling both sides of a 1st order drainage line up to 10m either side. The drainage line has moderately sloping banks with erosion and several exposed contour banks. Visibility was 40% in exposed areas and 20% in pasture areas. Total exposure area is 2,500 sq m. The site is approximately 160 m SE of existing site 50-5-0003/50-5-0083.	Outside study area. No Management required.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 22	Centroid			Travel E from Harefield on Pattersons Lane for approximately 1.5 km until the road starts to veer to the SE, where gas markers denote the road crossing. Follow the easement NE for approximately 600 m to Bucks Creek. The property may be accessed via a farm gate on the road bend approximately 200 m east of the pipeline road crossing.	Artefact Scatter	Rolling hills, Ridge, Stream bank, Terrace Flat	This site was originally recorded by Witter (1980) as an extensive low density artefact scatter measuring 850 x 50 m along Bucks Creek. The extent of the site was delimited by boundary fences and is thought to continue further. Site consists of the remains of 4 hearths, 6 stone tolls and a range of other stone artefacts (debitage) made from mostly quartz, but with silcrete, chert-slate and chacedony. This survey remained within the pipeline easement and identified 7 quartz artefacts on an exposure on the southern side of the creek. No evidence of hearths were observed in the pipeline easement.	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 23	Centroid			Travel E from the Olympic Way at Harefield along Pattersons Lane for approximately 1.5 km until the road starts to veer to the SE, where gas markers denote the road crossing. Cross the fenceline on the northern side of the road. The site is within this paddock on the flats below a rising slope to the NW.	Artefact Scatter	Rolling hills, Valley flat	This site consists of 4 quartz artfacts in an area measuring 150 x 20 m along the pipeline easement in a recently ploughed field offering 100% visibility, on the northern side of Pattersons Lane at Harefield. The artefacts included three flaked pieces, a core and a flake. The field had a scatter of quartz gravel throughout.	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 24	Centroid			Travel E from the Olympic Way at Harefield along Pattersons Lane for approximately 7 km and turn west into the property "Yarralumla". Park at the pipeline crossing and cross the fenceline on the northern side of the farm road, then walk north 70 m to the creek.	Artefact Scatter	Rolling hills, Stream bank, Terrace Flat.	This site consists of three quartz artefacts identified along the banks of Reedy Creek, which may form part of site 50-5-0009, although the site card was a little unclear as to the exact extent of that site. The area consists of scatters of quartz gravel and cobbles in the pipeline easement. One quartz flake and three quartz flaked pieces were recorded in the easement in a 50 x 10 m area on both sides of the creek on the flats within 3 m of the banks.	Destroy without salvage.
APA 25	Centroid			Travel E from the Olympic Way at Harefield along Pattersons Lane for approximately 7 km and turn west into the property "Yarralumla". Turn north at the first farm track to the right before the pipeline crossing, cross Reedy Creek, then turn west through a gate, approximately 200 m north of the creek. The site is on the this farm track approximately 60 m west of the gate.	Artefact Scatter	Undulating plain, Valley flat	This site consists of a quartz flake and a quartz core on a farm track in a paddock within valley flats. The site is 10 x 2 m approx 10 m NE of gas marker "115.3".	Destroy without salvage.
APA 26	Centroid			Travel E from the Olympic Way at Harefield along Pattersons Lane for approximately 7 km and turn west into the property "Yarralumla". Turn north at the first farm track to the right before the pipeline crossing, cross Reedy Creek, then turn west through a gate, approximately 200 m north of the creek. Follow pipeline easement north 130 m to the dam.	Artefact Scatter	Undulating plain, Valley flat	Area of exposure located on dam wall and along edges of a 2nd order drainage line (a branch of Reedy Creek). An area of 300 sq m exposed with 100% visibility. Low pasture elsewhere with	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 27	Artefact			Travel E from the Olympic Way along Shepard Siding Road, cross over Byrnes Road and continue along Shepherds Siding Road for approximately 200 m and take the left fork along Holloways Road. Follow Holloway Road eastwards for about 3.6 km (veering north ,then east again) to the pipeline crossing. Cross fence on north side of road and follow easement approximately 300 m to the mid-paddock gas marker. Site is 15 m east of the marker.	Isolated Find	Rolling hills, Valley flat	This site consists of one quartz flaked piece located 15 m east of a mid-paddock gas pipe sign, approx 1/3rd of the way between two drainage depressions. The site is probably part of previously recorded site 56-2-0001 which was recoded as having an area of 550 x 400 m on the northern drainage depression.	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 28	Artefact			Travel E from the Olympic Way along Shepard Siding Road, cross over Byrnes Road and continue along Shepherds Siding Road for approximately 200 m and take the left fork along Holloways Road. Follow Holloway Road eastwards for about 3.6 km (veering north ,then east again) to the pipeline crossing. Cross fence on north side of road and follow easement approximately 500 m. The site is on the eastern side of the existing pipeline route.	Isolated Find	Rolling hills, Valley flat	This site consists of a single quartz flaked piece amongst an area of quartz gravel and cobbles on an exposed cattle track (50 x 0.3 m) with 80% visibility. The site is located 100 m south of a 2nd order drainage depression and 200 m SE of a dam that straddles that depression. The site is probably part of previously recorded site 56-2-0001 which was recoded as having an area of 550 x 400 m on that drainage depression. The site area recorded in this survey was 5 x 1 m.	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 29	Centroid			Travel E from the Olympic Way along Shepard Siding Road, cross over Byrnes Road and continue along Shepherds Siding Road for approximately 200 m and take the left fork along Holloways Road. Follow Holloway Road eastwards for about 3.6 km (veering north, then east again) to the pipeline crossing. Cross fence on north side of road and follow easement approximately 650 m to the dam. The pipeline route crosses the creek approximately 30 m west of the dam wall.	Artefact Scatter	Rolling hills, Valley flat, Stream bank, Stream channel	This site was previously recorded by Witter (1980) in a 2nd order drainage line, which was recoded as having an area of 550 x 400 m on that drainage depression, including a burnt clay hearth, a partial charcoal hearth, and approximately 30 quartz debitage artefacts. A large dam has been constructed within the drainage depression, and exposures include the dam wall, adjacent contour banks and dam edges, with a total exposure of approx 2000 sq m. Observed site extent was 50 x 10 m with 80% visibility. Three quartz flaked pieces and five quartz gravel pieces were present. The AHIMS site card recommended total surface collection and limited excavation, but NPWS letter says archaeologists arrived too late to conduct salvage. Limited surface collection was undertaken. Witter's (1980) site map bears little resemblance to the site today.	Site is more extensive than the easement. Only a small percentage which has already been disturbed will be re-disturbed. Site was subject to surface salvage in 1980. Destroy affected section without salvage. The proponent should ensure that no construction activity occurs outside the easement at this location
APA 30	Artefact			Enter property "Walgowra" approximately 1.1 km north of Holloways Road on Pattersons Lane. Continue through farmhouse and shed complex to westen fence. Go through farm gate veering south and passing the circular grain bin. The site is on the farm track 6 m SE of the grain bin.	Isolated Find	Rolling hills, Ridge	This site consists of one quartz flaked piece (debitage) on a farm track approximately 6m.260 degrees from a grain bin. The site is 150 east of the pipeline route, therefore well outside the pipeline easement and will not be affected by construction.	Outside study area. No Management required.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 31	Centroid			From Pattersons Lane, turn north along Newells Lane and folllow north to the property at the far end of the road. Walk upslop to the west to the pipeline easement near the hilltop water tank and follow easement SE down the spur crest. The site is about mid-way down the slope and 43 degrees M to the water tank and 249 deg M to the gas marker on the south eastern fence of the paddock.	Artefact Scatter	Mid slope, Upper slope, Ridge	This site consists of three quartz artefacts amongs many large quartz gravel/cobbles scattered all the way down a moderately steep spur crest/slopes from a large water tank at the hill crest down to the boundary fence. The site covers an area of 30 x 10 m on the mid-slope area of the spur crest, approx 200 m downslope of the water tank. Artefacts include two quartz flakes and a quartz flaked pieces.	Destroy without salvage.
APA 32	Centroid			Travel E from the Olympic Way along Shepard Siding Road, cross over Byrnes Road and continue along Shepherds Siding Road for approximately 200 m and take the left fork along Holloways Road. Follow Holloway Road eastwards for about 2.9 km to where the road veers sharply north. Park and cross fence on south side of road and follow easement approximately 250 m.	Artefact Scatter	Rolling hills, Lower slope	This site consists of two quartz flaked pieces, approx 20 m apart, on the optical fibre cable trench mound clearing. The exposure for the mound is 1.25m wide with >80% visibility. The artefacts are likely to have been surfaced through previous trenching and, although in the current easement, are likely to be out of impact zone for this project.	Destroy without salvage.
APA 33	Centroid			Travel E from the Olympic Way along Shepard Siding Road, cross over Byrnes Road and continue along Shepherds Siding Road for approximately 200 m and take the left fork along Holloways Road. Follow Holloway Road eastwards for about 2.9 km to where the road veers sharply north. Park and cross fence on south side of road and follow easement approximately 480 m to near the crest of low NE-SW ridgeline. The site is approximately 30 m NE of a mid-paddock gas marker.	Artefact Scatter	Rolling hills, Upper slope	This site consists of two quartz flakes located 10 m east of the optical fibre trench mound (and on the mound itself) on a very gentle upper slope just below a ridge crest. The exposure for the mound is 1.25m wide with >80% visibility. Site area is 20 x 2 m.	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 34	Artefact			Travel E from the Olympic Way along Sheppard Siding Road, cross over Byrnes Road and continue along Shepherds Siding Road for approximately 200 m and take the left fork along Holloways Road. Follow Holloway Road eastwards for about 2.9 km to where the road veers sharply north. Park and cross fence on south side of road and follow easement approximately 660 m to a point 40 m east of the dam.	Isolated Find	Rolling hills, Lower slope	This site consists of one quartz flake on vehicle or cattle track 40 m east of a dam (which is on a 1st order drainage depression). The track is 2m wide with 80% visibility. The site is in the pipeline easement on a gentle lower slope.	Destroy without salvage.
APA 35	Centroid			Travel E from the Olympic Way along Shepard Siding Road, cross over Byrnes Road and continue along Shepherds Siding Road for approximately 200 m and take the left fork along Holloways Road. Follow Holloway Road eastwards for about 2.9 km to where the road veers sharply north. Park and cross fence on south side of road and follow easement SE, crossing fenceline with gas marker labellerd "555/120" and continue a further 320 m to the western end of the contour bank. The site is at the ned of the bank and on the adjacent track.	Artefact Scatter	Rolling hills, Mid slope	This site consists of a small artefact scatter on the edge of contour bank, midslope above the confluence of two 1st order drainage depressions. Six quartz artefacts present in a site area approx 20 x 20 m. The main exposure is a contour bank 1m wide with 60% visibility and on a vehicle/cattle track 2 m wide with 60% visibility.	Destroy without salvage.

Site No.	Point	MGA Easting *	MGA Northing *	Location	Site Type	Landform	Description	Management
APA 36	Centroid			From Byrns Road at Bomen, turn east on East Bomen Road and then turn left (north) into Buckman's Chemical facility. Follow road past the admin office turn-off, and park on roadside where gas pipeline crosses the road. Walk NE to the crest of a large hill with granite boulders outcropping. Artefacts are on the crest and NE upper slope.	Artefact Scatter	Ridge	This site consists of a scatter of artefacts on the crest of hill amongst heavy granite boulder outcropping. A series of small exposures of less than 1 sq m includes three quartz cores and five quartz flaked pieces, most of which is attributable to debitage. The site was identified by Ramsay Freeman as being of probable cultural significance due to its extensive outlook over valley flats to the east.	Site has been identified as being of possible cultural significance by Aboriginal stakeholders based on its outlook. The new pipeline trench should converge as close as possible to the existing pipeline to minimise any spread of impacts.

*** Note**: For confidentiality reasons the location coordinates for these sites have been omitted from the public exhibition version of this report. The coordinates were prvided in the government agency version.

Figures

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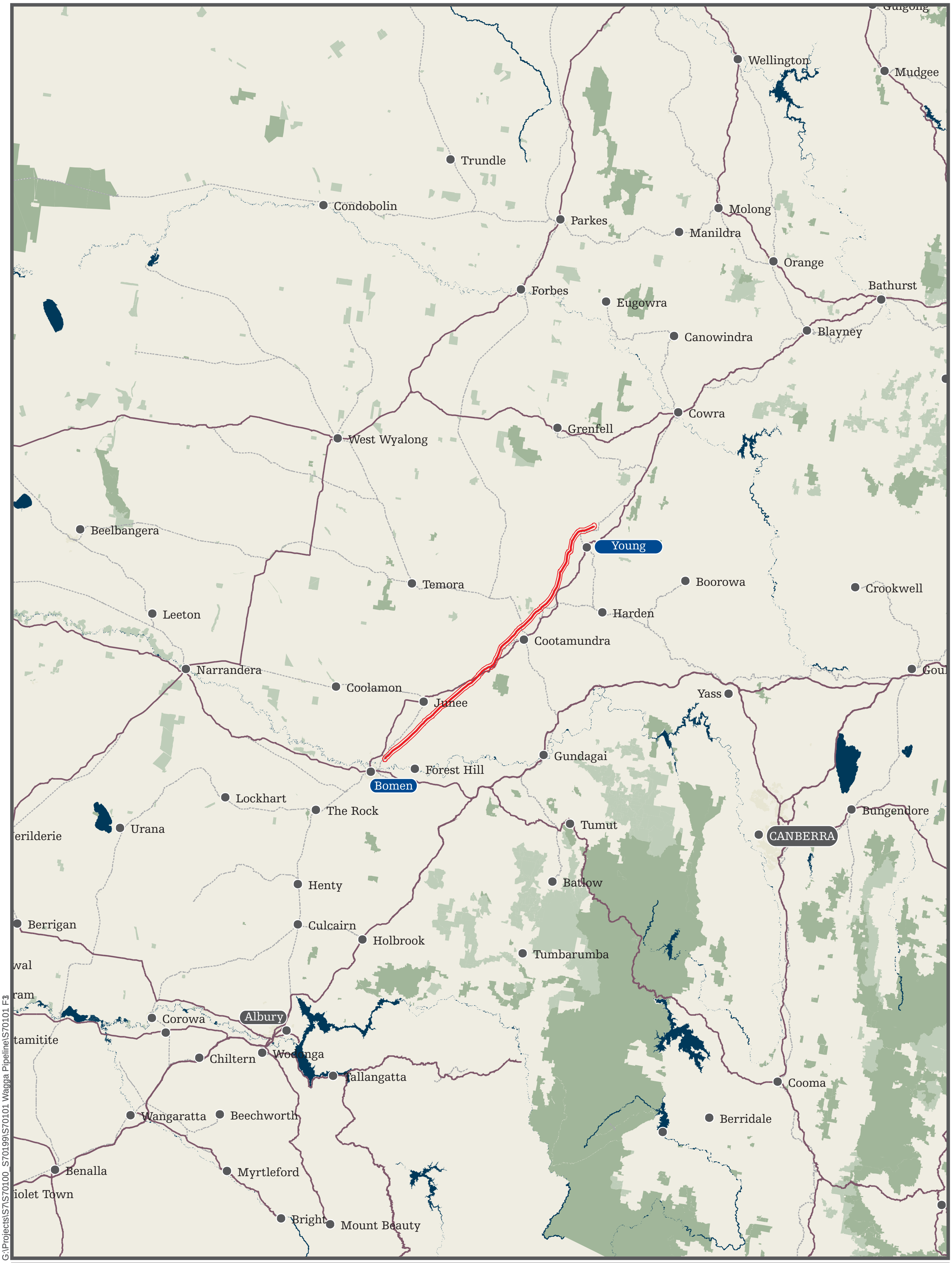

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PROJECT ID S70101
CREATED BY TO
LAST MODIFIED 22 10 2009

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0 50km

Proposed Pipeline Corridor
Highway
Railway
State Forest
National Parks Estate
Creek/River

Regional Context

APA Group Pty Ltd
Heritage Assessment: Young to Wagga Wagga Looping Pipeline
Young to Wagga Wagga, NSW

Figure
F1

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PROJECT ID S70101

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0 15km

- Proposed Stage 1 Pipeline Alignment (Wagga - Bethungra)
- Proposed Stage 2 Pipeline Alignment (Bethungra - Young)
- Proposed Pipeline Corridor
- Local Government Area Boundary
- Highway
- Road
- Railway
- State Forest
- Creek/River

Pipeline Staging

APA Group Pty Ltd

Heritage Assessment: Young to Wagga Wagga Looping Pipeline

Young to Wagga Wagga, NSW

Figure

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0 15km

Proposed Pipeline Corridor
Local Government Area Boundary
Highway
Road
Railway
State Forest
Creek/River
AHIMS Site Location

Site Location and AHIMS Site Search Results

APA Group Pty Ltd
Heritage Assessment: Young to Wagga Wagga Looping Pipeline
Young to Wagga Wagga, NSW

Figure
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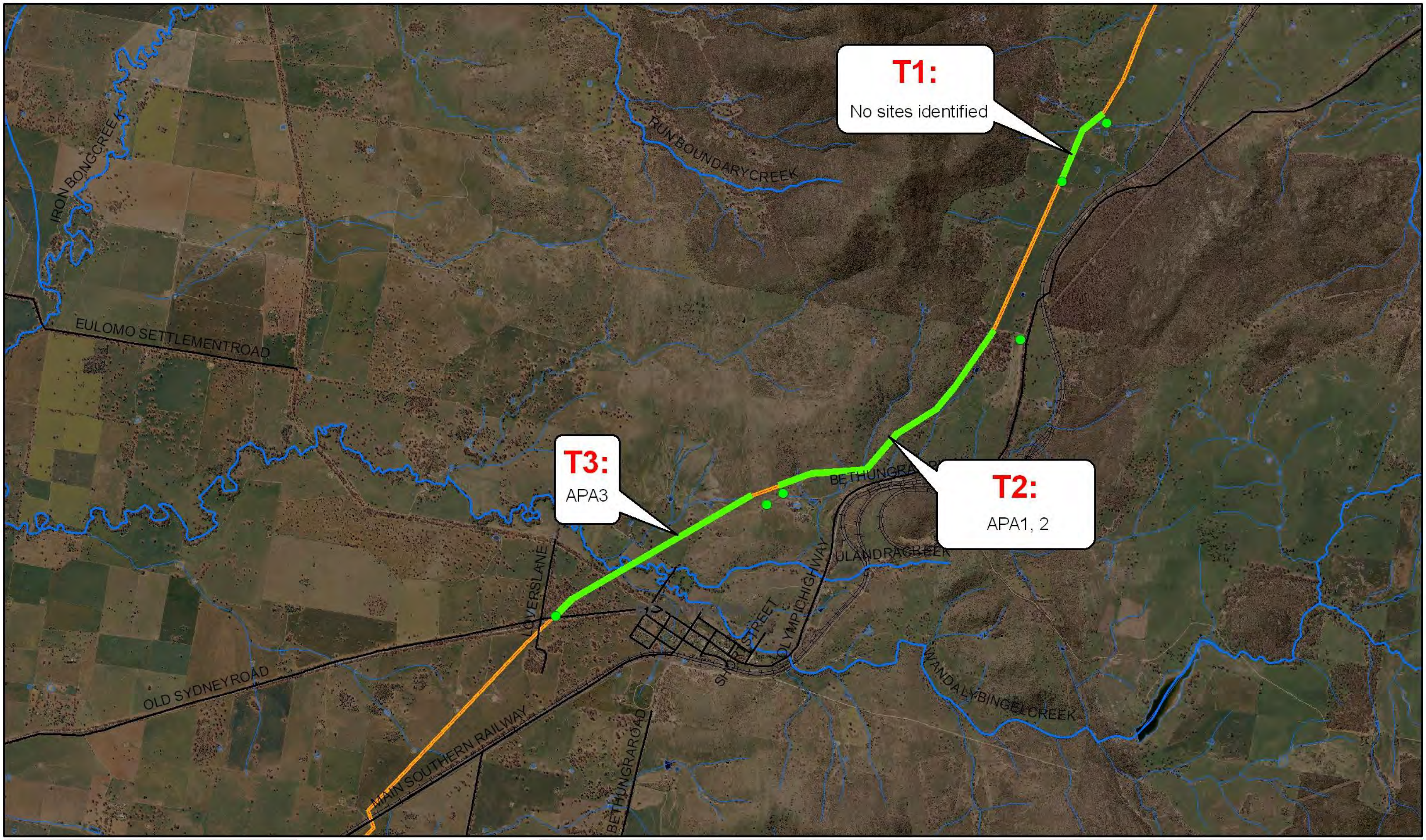

PROJECT ID: S70101
CREATED BY: DA
LAST MODIFIED: 29/01/2010

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Data source: Topographical data supplied by NSW Department of Lands

Transect Locations and Identified Aboriginal Sites - Sheet 1

APA Group Pty Ltd

Heritage Assessment: Young to Wagga Looping Pipeline, Young to Wagga Wagga, NSW

Figure F4

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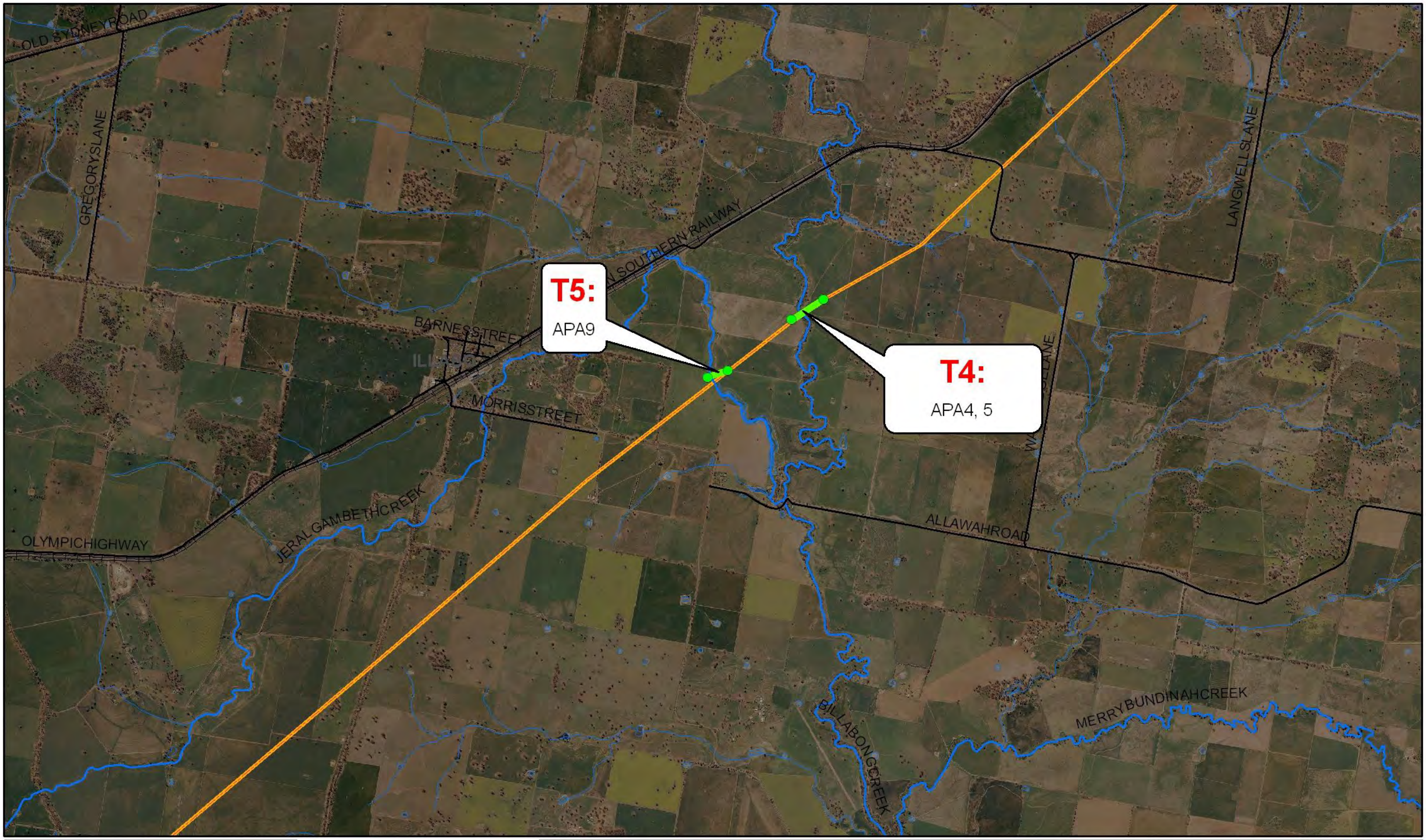

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0 500 1,000 2,000
Meters

Transect Start/Finish
Transect
Proposed Pipeline
Main Road
River/Creek
Railway

Data source: Topographical data supplied by NSW Department of Lands

Transect Locations and Identified Aboriginal Sites - Sheet 2

APA Group Pty Ltd

Heritage Assessment: Young to Wagga Looping Pipeline, Young to Wagga Wagga, NSW

Figure

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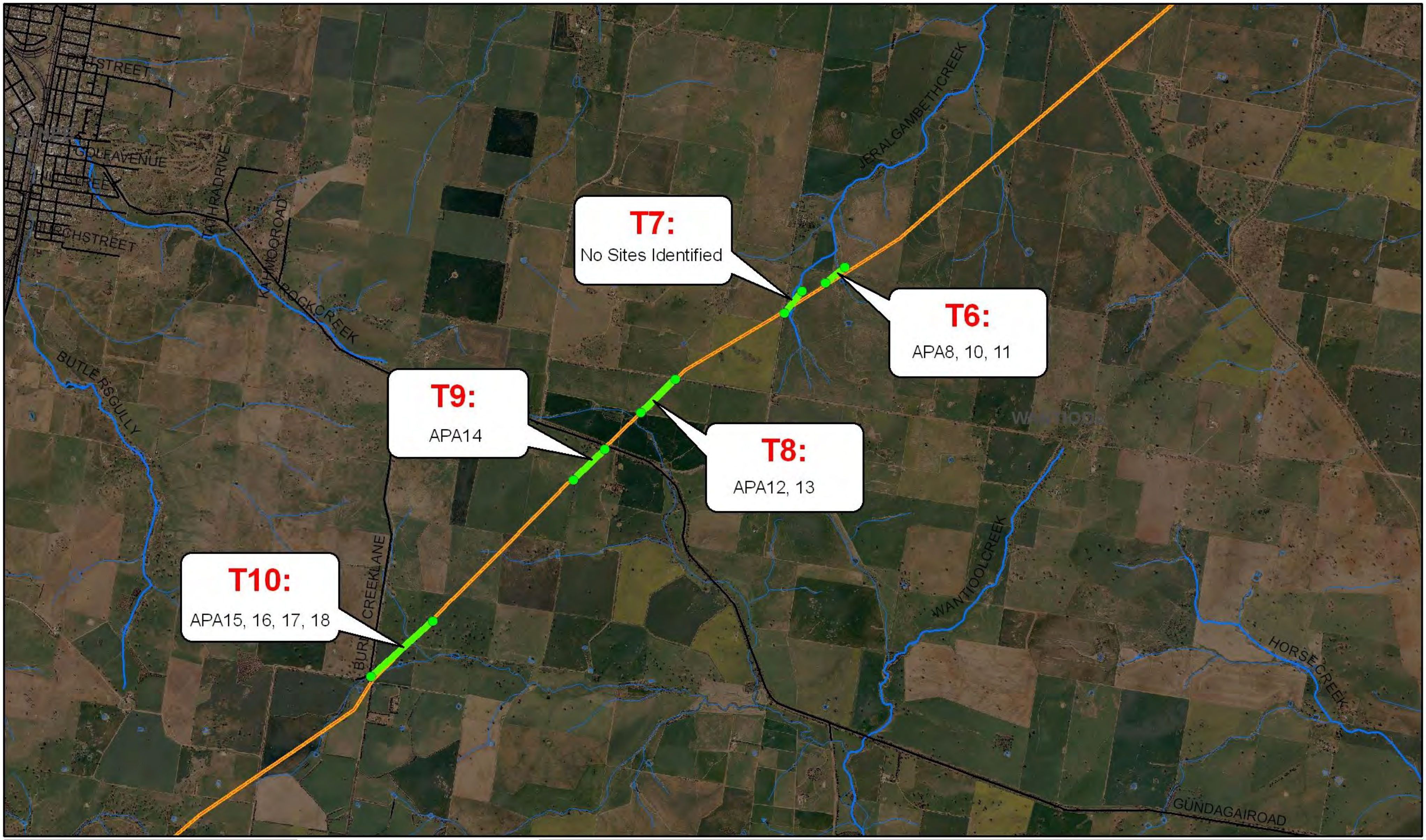

PROJECT ID: S70101
CREATED BY: DA
LAST MODIFIED: 29/01/2010

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0 500 1,000 2,000
Meters

- Transect Start/Finish
- Transect
- Proposed Pipeline
- Main Road
- River/Creek
- Railway

Data source: Topographical data supplied by NSW Department of Lands

Transect Locations and Identified Aboriginal Sites - Sheet 3

APA Group Pty Ltd

Heritage Assessment: Young to Wagga Looping Pipeline, Young to Wagga Wagga, NSW

Figure

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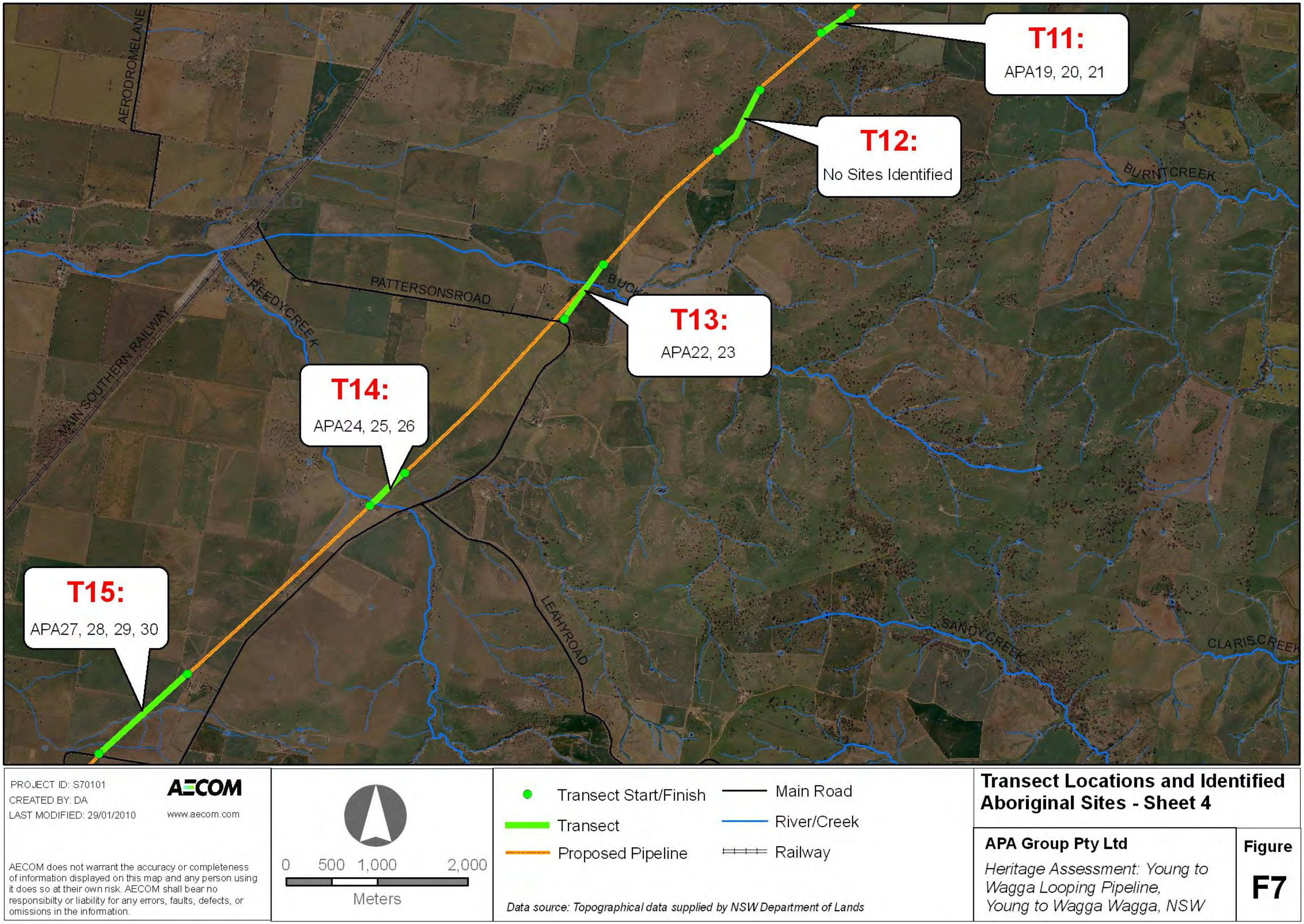

PROJECT ID: S70101
CREATED BY: DA
LAST MODIFIED: 29/01/2010

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Data source: Topographical data supplied by NSW Department of Lands

Transect Locations and Identified Aboriginal Sites - Sheet 4

APA Group Pty Ltd

Heritage Assessment: Young to Wagga Looping Pipeline, Young to Wagga Wagga, NSW

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LAST MODIFIED: 29/01/2010

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0 500 1,000 2,000
Meters

- Transect Start/Finish
- Transect
- Proposed Pipeline
- Main Road
- River/Creek
- Railway

Data source: Topographical data supplied by NSW Department of Lands

Transect Locations and Identified Aboriginal Sites - Sheet 5

APA Group Pty Ltd

Heritage Assessment: Young to Wagga Looping Pipeline, Young to Wagga Wagga, NSW

Figure F8

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Plates

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Plate P1: Dry creek bed of Ullandra Creek, looking east, Transect 3.

Plate P2: View south along Billabung Creek (eastern branch), Transect 4

Plate P3: View north along Billabung Creek (eastern branch), Transect 4.

Plate P4: Low undulating country, north east of Bomen showing typical cropped drainage depressions.

Plate P5: View southwest along Transect 5, showing heavy pasture and crop.

Plate P6: View from mid slope across Transect 6 showing topography typical for the study area.

Plate P7: Typical landscape view showing cleared landscape under wheat crops.

Plate P8: Cleared easement showing stripped and disturbed topsoil in Transect 16, south of Holloways Road, Shepherds Siding.

Plate P9: Typical level of exposure for study area, Transect 5.

Plate P10: Exposure level typical for the study area, Transect 6.

Plate P11: Typical landscape modification in study area, Transect 6: contour bank for moving water to a dam. Wheat crop and levels of exposure are also typical.

Plate P12: Typical streambank erosion, showing level of exposure on an un-named 2nd-order drainage line east of Junee, Transect 7

Plate P13: Streambank erosion east of Junee, Transect 7

Plate P14: Quartz flake typical of the material found along the study area, Site APA 6, Transect 5.

Plate P15: View across site APA 20 (AHIMS 50-5-0083), Transect 11.

Plate P16: Site of possible waterholes identified by Witter (1980), APA 20 (AHIMS 50-5-0083).

Plate P17: View south towards site APA 36, Transect 18.

Plate P18: Typical quartz artefact found in low-density scatter at APA36, Transect 18

Plate P19: Image showing views south from APA36 towards extensive alluvial plains.

Plate P20: 1st order streamline, Transect 10, showing level of cover by pasture and nearby wheat crop.

Plate P21: Undulating terrain typical of that along the study area, Transect 11.

Plate P22: Level of ground coverage in study area, Transect 11.

Plate P23: Typical surface exposure, Transect 16.

Plate P24: Landscape and Topography typical of the study area, Transect 16.

Plate P25: View north east along pipeline easement, showing cleared trees, Transect 3.

Plate P26: View north east along pipeline easement from the end of Transect 3, showing increasingly hilly terrain of Bethungra Range.

Plate P27: Foothills of Bethungra Range, Transect 2.

Appendix A

AHIMS Search Results

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SITE_ID	SITE_NAME	GRID	ZONE	EASTING	NORTHING	MGA E	MGA N	Site Type	EVIDENCE	VALIDITY	MGMT_SU	STATE_ARCH
50-3-0002	BY 12 Young	AGD	55	613413	6205397	613518	6205586	Open Camp Site	Reason	VAL	Environm	NRS/17798/1/453
50-3-0003	BY 13 Stoney Creek	AGD	55	612711	6202374	612816	6202563	Open Camp Site	Directions:	VAL	Condition:	NRS/17798/1/453
50-3-0004	Wombat BY 14 Tumbleton Cre	AGD	55	608608	6192283	608713	6192472	Open Camp Site	Reason	VAL	Environm	NRS/17798/1/453
50-5-0003	Junee BY 5	AGD	55	554091	6133530	554196	6133719	Water Hole; Open	Reason	VAL	the ingredi	NRS/17798/1/453
50-5-0004	Billabong Creek Illabo BY	AGD	55	570405	6146944	570510	6147133	Open Camp Site	Reason	VAL		NRS/17798/1/453
50-5-0005	Billabong Creek BY 7	AGD	55	570949	6147406	571054	6147595	Open Camp Site	Reason	VAL		NRS/17798/1/453
50-5-0006	Bethungra BY 8	AGD	55	577284	6153592	577389	6153781	Open Camp Site	Reason	VAL	Environm	NRS/17798/1/453
50-5-0007	Frampton BY 9	AGD	55	582714	6158946	582819	6159135	Open Camp Site	Reason	VAL	Environm	NRS/17798/1/453
50-5-0008	Junee BY 15 Wanitool Creek	AGD	55	559618	6138246	559723	6138435	Open Camp Site	Reason	VAL	Environm	NRS/17798/1/453
50-5-0009	Harefield Bucks Creek BY4	AGD	55	551561	6130580	551666	6130769	Open Camp Site	Reason	VAL	Environm	NRS/17798/1/453
50-5-0011	Harefield BY3 Reedy Creek	AGD	55	548840	6128542	548945	6128731	Open Camp Site	Reason	VAL	Relation to	NRS/17798/1/453
50-5-0036	Illabo-Tumut Pipeline Site IT:	AGD	55	567382	6143324	567487	6143513	Open Camp Site	Reason	VAL	Site conte	NRS/17798/1/453
50-5-0037	Illabo-Tumut Pipeline Site IT	AGD	55	567126	6143589	567231	6143778	Open Camp Site	Reason	VAL	Scatter are	NRS/17798/1/453
50-5-0038	Bethungra Scarred Tree	AGD	55	578000	6153600	578105	6153789	Scarred Tree	Directions	VAL		NRS/17798/1/453
50-5-0076	Illabo-Tumut Pipline Site:IT:	AGD	55	567126	6143589	567231	6143778	Open Camp Site		VAL		
50-5-0078	OS - 1 Witter 1980, BY 6	AGD	55	570070	6146940	570175	6147129	Open Camp Site		VAL		
50-5-0079	OS - 2	AGD	55	570290	6147070	570395	6147259	Open Camp Site		VAL		
50-5-0080	OS - 3	AGD	55	558770	6137710	558875	6137899	Open Camp Site		VAL		
50-5-0081	OS - 4	AGD	55	559920	6138490	560025	6138679	Open Camp Site		VAL		
50-5-0082	QS - 1	AGD	55	571050	6147660	571155	6147849	Stone Quarry		VAL		
50-5-0083	BY5	AGD	55	553770	6133260	553875	6133449	Water Hole		VAL		
50-6-0002	Cootamundra BY 10	AGD	55	591203	6168991	591308	6169180	Open Camp Site	Reason	VAL	Relation to	NRS/17798/1/454
50-6-0003	Muttama Creek BY 11	AGD	55	593466	6171116	593571	6171305	Open Camp Site	Reason	VAL		NRS/17798/1/454
50-6-0004	Connaughtmans Creek, Waller	AGD	55	605310	6183843	605415	6184032	Scarred Tree	Reason	VAL		NRS/17798/1/454
56-1-0043	EAST BOMEN 1	AGD	55	538530	6118940	538635	6119129	Isolated Find		VAL		NRS/17798/1/555
56-1-0045	EAST BOMEN IF1	AGD	55	539300	6118850	539405	6119039	Isolated Find		VAL		NRS/17798/1/555
56-2-0001	Shepherd Siding BY2	AGD	55	546399	6125959	546504	6126148	Open Camp Site		VAL		NRS/17798/1/556

Count of Site Type	
Site Type	Total
Isolated Find	2
Open Camp Site	20
Scarred Tree	2
Stone Quarry	1
Water Hole	1
Water Hole; Open Camp Site	1
Grand Total	27

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Appendix B

AHIMS Site Cards

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For confidentiality reasons the AHIMS site cards have been omitted from the public exhibition version of this report. All site cards were retained within the government agency version to allow adequate review of the document.

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Appendix C

Aboriginal Community Consultation Log and Correspondence

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Date	Stakeholder Group	Stakeholder Representative	Correspondence/Comments	AECOM Representative
28/08/2009	WWLALC	Lorraine Lyons	Lorraine rang to advise she had seen the ad in the newspaper on Saturday last and wanted to register interest in the project. I asked if she had received the letter we sent on 21/8/09 - she hadn't.	Rick Bullers
28/08/2009	WWLALC	Lorraine Lyons	Emailed copy of the letter. Found out the letters weren't sent until Wednesday 26/8/09.	Rick Bullers
28/08/2009	Junee Shire Council	Anthony Newland	Received email advising that Shirley Buckland would be Junee Shire's best indigenous contact.	Rick Bullers
28/08/2009	Junee Shire Council	Anthony Newland	Emailed Anthony to see if he had Shirley Buckley's contact details.	Rick Bullers
31/08/2009	YLALC	Norma Freeman	Faxed ROI response form, registering YLALC and nominating five individuals from the Young area that may be interested in consultation.	Rick Bullers
31/08/2009	(Individual)	Ramsay Freeman	Received voicemail message from Ramsay. Rang back 1/9/09 and Ramsay asked what he had to do. Advised that he would be registered as a stakeholder but I asked if he could send in a letter registering interest.	Rick Bullers
2/09/2009	Cootamundra Shire Council	Gary Arthur	Received voicemail message from Gary stating that the best contact in the Cootamundra Shire is Craig Cromelin on 0448 274 057	Rick Bullers
3/09/2009	(Individuals)	Ramsay Freeman, Peter Williams & Janice Considine	Received three separate letters (dated 1/9/09) from each individual in one package, expressing interest in consultation.	Rick Bullers
3/09/2009	(individual)	Shirley Marlowe	Received letter (via email) dated 3/9/09 expressing interest in consultation.	Rick Bullers
3/09/2009	(individual)	Craig Cromelin	Rang to see if he would be interested in registering. He said he would, so was registered.	Rick Bullers
3/09/2009	(individual)	Craig Cromelin	Sent email requesting his postal address.	Rick Bullers
4/09/2009	(individual)	Dean Freeman	Received phone call and email registering interest in consultation	Rick Bullers
4/09/2009	(individual)	Janice Considine	Received phone call to check that mailed ROIs received.	Rick Bullers
4/09/2009	(individual)	Neville Williams	Received phone call registering interest for himself plus Shawn, Wayne and Sharon Williams.	Rick Bullers

4/09/2009	(individual)	Mitchell Cutmore	Received phone call registering interest for himself plus Stuart Cutmore	Geodie Oakes
7/09/2009	(individual)	Neville Williams	Received letter by fax registering interest for himself plus Shawn, Wayne and Sharon Williams.	Rick Bullers
10/09/2009	DECC	Stephen Free	Received fax nominating four potential stakeholder groups (three groups not previously known plus YLALC).	Rick Bullers
23/09/2009	(individual)	Sharon Williams	Received methodology response form - no comment on methodology, no insurance, no CV.	Rick Bullers
23/09/2009	YLALC	Norma Freeman	Received methodology response forms for four individuals - Kieth Freeman, Enid Clarke, Krystal Ingram & Barry McDonnell - no CVs, no insurance cover, all support methodology	Rick Bullers
24/09/2009	(individual)	Janice Considine	Janice rang and lefty message asking me to call her	Rick Bullers
24/09/2009	HaddiGaddi Koori Services	Dean Freeman	Received letter in respons to methodology statement. Agrees and supports the methodology - CVs attached, insurance attached (no personal accident cover)	Rick Bullers
26/09/2009	(individual)	Wayne Williams	Received methodology response form (no comment), CV, no insurance.	Rick Bullers
26/09/2009	(individual)	Neville Williams	Received methodology response form (no comment), CV, no insurance.	Rick Bullers
28/09/2009	(individual)	Shawn Williams	Received methodology response form (no comment), CV, no insurance.	Rick Bullers
28/09/2009	(individual)	Dean Freeman	Dean rang and left message asking me to call.	Rick Bullers
28/09/2009	(individual)	Mitchell Cutmore	Received methodology response form - no comment on methodology, no insurance, no CV.	Rick Bullers
28/09/2009	(individual)	Stuart Cutmore	Received methodology response form - no comment on methodology, no insurance, no CV.	Rick Bullers
29/09/2009	(individual)	Ramsay Freeman	Returned call to Janice Considine but spoke to her father Ramsay Freeman. Asked if they had any comments on the methodology - he said no we appear to be targeting the right areas. He also said he would get their CVs to me by next week (still waiting to get them from anotherarchaeologist). Registered with Manpower (insured).	Rick Bullers

1/10/2009	(individual)	Ramsay Freeman	RF called to query accommodation costs. He had received a call from Manpower to discuss employment last week and advised them that we would not be paying expenses. He rang toquery and mentioned that others had also queried it. He would call Manpower and ask them to call the Canberra office to follow up (I called Dale Newsome in Canberra to discuss with him and he would query the client as to whether they would pay).	Rick Bullers
2/10/2009	WWLALC	Lorraine Lyons	Called and emailed WWLALC to discuss methodology statement and fieldwork. Noone answered - left voicemail message.	Rick Bullers
2/10/2009	(individual)	Dean Freeman	Called and emailed Dean to discuss fieldwork. Left Message. Dean call and agreed to 2 days fieldwork on Thursday 8/10 and Friday 9/10.	Rick Bullers
2/10/2009	WWLALC	Lorraine Lyons	Called again to discuss fieldwork (afternoon). Still no reply. Left another message.	Rick Bullers
2/10/2009	WWLALC	Lorraine Lyons	LL rang back to discuss. She will try to get someone to come. Arranged to call each other on Monday to confirm. Arranged meeting place at Bethungra.	Rick Bullers
7/10/2009	WWLALC	Lorraine Lyons	Rang to see if she had arranged a field rep. Unable to find someone so WWLALC not participating in file survey.	Rick Bullers
30/10/2009	WWLALC	Lorraine Lyons	Rang LL to see if they would be able to send some reps to take part in additional fieldwork around Bethungra on Thursday 5/11/09. Not available, left message.	Rick Bullers
30/10/2009	WWLALC	Lorraine Lyons	LL rang back and left voicemail message stating that she would have two reps available on Thursday 5/11 and would confirm next week.	Rick Bullers
3/11/2009	WWLALC	Natalie	Rang WWLALC four times during the day. Natalie advised that LL was in meetings. Asked if LL could call me ASAP to confirm fieldwork on Thursday. Natalie said she would pass message on (on last call Natalie said she had passed the message on).	Rick Bullers
3/11/2009	WWLALC	Lorraine Lyons	Sent email requesting LL to call me. No response	Rick Bullers

4/11/2009	WWLALC	Natalie	Rang but Natalie said LL was on her way to another meeting. Advised natalie of urgency of confirmation so we could confirm flights. Natalie said she would get LL to call as soon as she got back. She also gave me the LALC's mobile.	Rick Bullers
4/11/2009	WWLALC	Lorraine Lyons	Sent email showing additional transects and two site cards at Ullandra Creek. Requested that LL contact me urgently.	Rick Bullers
4/11/2009	WWLALC	Lorraine Lyons	Tried calling LL on LALC mobile. No answer.	Rick Bullers
4/11/2009	WWLALC	Lorraine Lyons	Cancelled fieldwork this week due to no reply from WWLALC	Rick Bullers
4/11/2009	WWLALC	Lorraine Lyons	Called p.m. LL advised that she has been trying to get someone but unable to for this week. I advised her that it has been postponed til next week. LL adivised that she is advertising for someone locally (don't have permanent staff) and may have Damien coming from Hay. I asked if she could confirm on Friday, else we would have to engage other groups. LL agreed to confirm Friday 6/11.	Rick Bullers
12/01/2010	All stakeholders	All representatives	Sent copy of draft report to all registered stakeholders asking for comments to be received by Friday 29/1/2010.	Rick Bullers
25/01/2010	Individuals	Neville williams (on behalf of Saron, Wayne and Shawn Williams)	Received faxed letter providing feedback on the draft report.	Rick Bullers
28/1/2010	(individual)	Ramsay Freeman	Rang Ramsay to obtain further information on the cultural heritage significance specifically in relation to APA36. He advised that, in his opinion, the site would have very high significance based on the fact that artefacts are there, it is amongst granite boulders and it has extensive outlook over the south and west towards a large creek.	Rick Bullers

Aboriginal Consultation Process

Project: Young to Wagga Wagga Natural Gas Looping Pipeline: Bethungra to Wagga Wagga

Stage 1 - Advisory Requests Sent

	Contact	Date Sent	Comment
Local Newsapaper Ad		21-Aug-09	Advertised in the *Daily Advertiser* on Saturday 22 August 2009.
DECCW		21-Aug-09	Received email on 28/8/09 advising that the request had been received. Received faxed response 10/9/09 advising four potential stakholder groups (three not previously contacted).
LALC - WWLALC	Lorraine lyons	21-Aug-09	Received phone call 28/8/09 advising verbal registration of interest after seeing advertisement in local newspaper.
LALC - YLALC	Norma Freeman	21-Aug-09	Received fax 31/8/09 registering interest in the project (between Young and Bethungra) and providing a list of interested individuals (whole route). No initial information on the cultural values of the study area provided.
Registrar Aboriginal Owners		21-Aug-09	Received letter dated 31/8/09 advising no Registered Aboriginal Owners. Advised consulting with WWLALC and YLALC.
Native Title Services		21-Aug-09	No response
National Native Title Tribunal		06-Nov-09	Received letter date 6/11/09 stating that there were no registered native title claimants in the study area.
Local Council - Cootamundra	Gary Arthur	02-Sep-09	Received voicemail message stating that Craig Cromelin would be the best contact in this LGA. Rang Craig who subsequently registered interest.
Local Council - Junee	Anthony Newland	21-Aug-09	Received email on 28/8/09 advising that Shirley Buckley would be the best contact in Junee Shire.
Local Council - Wagga Wagga	Vanessa Pattison	21-Aug-09	Received telephone call 7/12/09 apologising for the late response, but the request had only just gone through the Council system and arrived at her desk! Vanessa was advised that the fieldwork and draft report for Stage 1 had been completed and so no further Aboriginal stakeholders could take part.

Aboriginal Group Notifications Sent (DATE) - see "addresses" sheet

Aboriginal Group Registrations & Communications

Organisation	Contact person	Date	Comments
WWLALC	Lorraine Lyons	28-Aug-09	Received telephone call registering interest in the project.
YLALC	Norma Freeman	31-Aug-09	Received faxed response form registering interest (no comments on cultural heritage information given) - also recommended five Aboriginal individuals (see below).
Individual	Shirley Buckley		Recommended by Junee Shire Council. Called and left message inviting registration - no response received.
Individual	Enid Clarke		
Individual	Keith Freeman		
Individual	Krystal Ingram	31-Aug-09	Individuals recommended by YLALC. Each individual registered separately.
Individual	Barry McDonnell		
Individual	Isobel Charles		
Individual	Ramsay Freeman	01-Sep-09	Received letter expressing interest in consultation.
Individual	Peter Williams	01-Sep-09	Received letter expressing interest in consultation.
Individual	Janice Considine	01-Sep-09	Received letter expressing interest in consultation.
Individual	Shirley Marlow	03-Sep-09	Received emailed letter expressing interest in consultation.
NSW Aboriginal Land Council -	Craig Cromelin	03-Sep-09	Recommended by Cootamundra Shire Council. Called and invited registration (accepted).
Individual	Dean Freeman	04-Sep-09	Received email expressing interest in consultation.
Individual	Neville Williams		
Individual	Shawn Williams	05-Sep-09	Received faxed letter on behalf of four individuals expressing interest in consultation
Individual	Wayne Williams		
Individual	Sharon Williams		
Individual	Mitchell Cutmore	04-Sep-09	Received telephone call registering interest for both individuals

Individual	Stuart Cutmore	04-Sep-09	Received telephone call registering interest for both individuals.
Gundungarra Aboriginal Heritage	Sharyn Halls		Recommended by DECC.
Stage 2 - Briefing & Methodology Advice Sent & Comments Received			
Organisation	Contact person	Date Sent	Comments
WWLALC	Lorraine Lyons	07-Sep-09	No response received.
YLALC	Norma Freeman	07-Sep-09	No response received. YLALC forwarded response forms for four individuals - Kieth Freeman, Enid Clarke, Krystal Ingram & Barry McDonnell - no CVs, no insurance cover, all support methodology
Individual	Enid Clarke	07-Sep-09	Supports methodology
Individual	Keith Freeman	07-Sep-09	Supports methodology
Individual	Krystal Ingram	07-Sep-09	Supports methodology
Individual	Barry McDonnell	07-Sep-09	Supports methodology
Individual	Isobel Charles	07-Sep-09	No response received
Individual	Ramsay Freeman	07-Sep-09	Rang Ramsay (& Jancice Considine) - gave verbal support for methodology.
Individual	Peter Williams	07-Sep-09	No response received
Individual	Janice Considine	07-Sep-09	Rang Ramsay (& Jancice Considine) - gave verbal support for methodology.
Individual	Shirley Marlow	07-Sep-09	No response received
NSWALC	Craig Cromelin	07-Sep-09	No response received
Individual	Dean Freeman	07-Sep-09	Received letter 24/9/09 supporting methodology and providing CV and insurance.
Individual	Neville Williams	07-Sep-09	Received response form 26/9/09 - no comments made, CV attached, insured through Manpower
Individual	Shawn Williams	07-Sep-09	Received response form 28/9/09 - no comments made, CV attached, insured through Manpower
Individual	Wayne Williams	07-Sep-09	Received response form 26/9/09 - no comments made, CV attached, insured through Manpower
Individual	Sharon Williams	07-Sep-09	Received response form 26/9/09 - no comments made, no CV and no insurance
Individual	Mitchell Cutmore	07-Sep-09	Received response form 28/9/09 - no comments made, no CV, possibly insured through Manpower
Individual	Stuart Cutmore	07-Sep-09	Received response form 28/9/09 - no comments made, no CV, possibly insured through Manpower
GAHA	Sharyn Halls	07-Sep-09	No response received
Stage 3 - Draft Reports for Review - Sent			
Organisation	Contact person	Date Sent	Feedback Received & Date
WWLALC	Lorraine Lyons	12-Jan-10	Did not provide formal comment.
YLALC	Norma Freeman	12-Jan-10	Did not provide formal comment.
Individual	Enid Clarke	12-Jan-10	Did not provide formal comment.
Individual	Keith Freeman	12-Jan-10	Did not provide formal comment.
Individual	Krystal Ingram	12-Jan-10	Did not provide formal comment.
Individual	Barry McDonnell	12-Jan-10	Did not provide formal comment.
Individual	Isobel Charles	12-Jan-10	Did not provide formal comment.
Individual	Ramsay Freeman	12-Jan-10	Did not provide formal comment, but during a telephone conversation on 28 January 2010 Mr Freeman reiterated that he felt that site APA36 has high cultural heritage significance.
Individual	Peter Williams	12-Jan-10	Did not provide formal comment.
Individual	Janice Considine	12-Jan-10	Did not provide formal comment.
Individual	Shirley Marlow	12-Jan-10	Did not provide formal comment.
NSWALC	Craig Cromelin	12-Jan-10	Did not provide formal comment.
Individual	Dean Freeman	12-Jan-10	Did not provide formal comment.
Individual	Neville Williams	12-Jan-10	Provided clarification on previous comments made. Requests a meeting of all stakeholders to discuss the project, particularly in relation to methodology, further survey work and/or test excavation, monitoring during construction.
Individual	Shawn Williams		
Individual	Wayne Williams		
Individual	Sharon Williams		
Individual	Mitchell Cutmore	12-Jan-10	Did not provide formal comment.
Individual	Stuart Cutmore	12-Jan-10	Did not provide formal comment.

Our reference : DOC09/42497
Contact : Stephen Free (02) 6298 0372

Mr Rick Bullers
Senior Archaeologist
ENSR Australia Pty Ltd
PO Box 726
PYMBLE NSW 2073

FAXED
02-8484-8989
2:20pm.

Dear Rick,

WRITTEN NOTIFICATION OF PROPOSAL AS REQUIRED UNDER DECC INTERIM COMMUNITY CONSULTATION REQUIREMENTS FOR APPLICANTS RE: PROPOSED GAS PIPELINE BETWEEN WAGGA WAGGA AND YOUNG, NSW – CULTURAL HERITAGE ASSESSMENT

I refer to your letter dated 21 August 2009 to the Department of Environment and Climate Change (DECC) regarding the above matter.

Attached is a list of known Aboriginal parties that DECC feels is likely to have an interest in the development. Please note this list is not necessarily an exhaustive list of all interested Aboriginal parties and receipt of this list does not remove the requirement of a proponent/ consultant to advertise in local print media and contact other bodies seeking interested Aboriginal parties, in accordance with the Interim Requirements.

If you wish to discuss any of the above matters further please contact me on (02) 6229 7087.

Yours sincerely

STEPHEN FREE
Senior Aboriginal Heritage Officer/Archaeologist,
Aboriginal Heritage Regulation Unit
<u>Environmental Protection and Regulation Group South</u>
10 September 2009

PO Box 733, Queanbeyan, NSW 2620
6 Rutledge Street, Queanbeyan, NSW 2620
Tel: (02)6299 2929 Fax: (02) 6299 4281
ABN 30 841 387 271
www.environment.nsw.gov.au

Department of **Environment & Climate Change** NSW

Organisation/Individual Name	Address	Contact Details
Pejar Local Aboriginal Land Council Primary Contact: Delise Freeman	80 Combermere St, PO Box 289, Goulburn NSW 2580	Ph: (02) 4822 3552 Fax: (02) 4822 3551 pejar1@goulburn.net.au
Cowra Local Aboriginal Land Council	PO Box 769, Cowra NSW 2704	ph: (02) 6342 4808
Gundungurra Aboriginal Heritage Association Inc. Secretary Sharyn Halls	PO Box 31, Lawson NSW 2783	

5 August 2009
Ms Norma Freeman
CEO
Young Local Aboriginal Land Council
247 Boorowa Street
YOUNG NSW 2564
Phone. 02 6382 5669
ylalc@yahoo.com.au

Draft Advertisement

Public Notices Section

Aboriginal Stakeholder Consultation
Wagga Wagga, Cootamundra, Junee, Harden and Young Local Government Areas.
ENSR Australia Pty Ltd (trading as AECOM) is seeking to identify Aboriginal stakeholders who wish to be consulted in relation to a proposed archaeological survey associated with the development of a gas pipeline between Young and Wagga Wagga, NSW. Interested stakeholders are requested to register their interest in writing to:

Rick Bullers
AECOM
PO Box 726, PYMBLE NSW 2073
T: 02 8484 8999
F: 02 8484 8989
E: rick.bullers@aecom.com

Expressions of interest should include current contact details. The closing date for registration is close of business on Insert Date. Registration does not guarantee employment during fieldwork.

National Native Title Tribunal

New South Wales and Australian Capital Territory Registry
Level 25, 25 Bligh Street
Sydney NSW 2000
GPO Box 9973
Sydney NSW 2000
Telephone (02) 9235 6300
Facsimile (02) 9233 5613

6 November 2009

Rick Bullers
Professional Archaeologist
AECOM
Level 5, 828 Pacific Highway
Gordon NSW 2072

Our Reference: 3137/09to

Dear Mr Bullers

Native Title Search Results of Proposed Pipeline between Young and Wagga Wagga

Thank you for your email of 5 November 2009.

My search on 6 November 2009 found:

Register Type	**NNTT Reference Numbers**
National Native Title Register	Nil.
Register of Native Title Claims	Nil.
Unregistered Claimant applications	Nil.
Register of Indigenous Land Use Agreements	Nil.

I have included a NNTT Registers fact sheet to help you understand the search result.

Please note that there may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed in the Federal Court may not appear on the Tribunal's databases.

If you need more information please call me on 1800 640 501.

Yours sincerely

Tom O'Reilly
Senior Case Officer

Telephone (02) 9235 6315
Facsimile (02) 9235 5613
Email tom.o'reilly@nntt.gov.au

Encl

Searching the NNTT Registers in New South Wales

Search service
On request the National Native Title Tribunal will search its public registers for you. A search may assist you in finding out whether any native title applications (claims), determinations or agreements exist over a particular area of land or water.

In New South Wales native title cannot exist on privately owned land including family homes or farms.

What information can a search provide?
A search can confirm whether any applications, agreements or determinations are registered in a local government area. Relevant information, including register extracts and application summaries, will be provided.

In NSW because we cannot search the registers in relation to individual parcels of land we search by local government area.

Most native title applications do not identify each parcel of land claimed. They have an external boundary and then identify the areas not claimed within the boundary by reference to types of land tenure e.g., freehold, agricultural leasehold, public works.

What if the search shows no current applications?
If there is no application covering the local government area this only indicates that at the time of the search either the Federal Court had not received any claims in relation to the local government area or the Tribunal had not yet been notified of any new native title claims.

It does not mean that native title does not exist in the area.

Native title may exist over an area of land or waters whether or not a claim for native title has been made.

Where the information is found
The information you are seeking is held in three registers and on an applications database.

National Native Title Register
The National Native Title Register contains determinations of native title by the High Court, Federal Court and other courts.

Register of Native Title Claims
The Register of Native Title Claims contains applications for native title that have passed a registration test.

Registered claims attract rights, including the right to negotiate about some types of proposed developments.

Register of Indigenous Land Use Agreements
The Register of Indigenous Land Use Agreements contains agreements made with people who hold or assert native title in an area.

The register identifies development activities that have been agreed by the parties.

Application summaries
An application summary contains a description of the location, content and status of a native title claim.

This information may be different to the information on the Register of Native Title Claims, e.g., because an amendment has not yet been tested.

How do you request a search?

A search request form is available on the Tribunal's web site at:
http://www.nntt.gov.au/registers/search.html
This form says how much searches cost.
Mail, fax or email your request to the Tribunal's Sydney registry, identifying the local government area/s you want searched.

Email: SydneySearch@nntt.gov.au
Fax: (02) 9233 5613
Address: GPO Box 9973, Sydney NSW 2001
Phone: (02) 9235 6300

OFFICE OF THE REGISTRAR
ABORIGINAL LAND RIGHTS ACT 1983 (NSW)

11-13 Mansfield Street
Glebe NSW 2037
PO Box 112, Glebe NSW 2037
P. 02 9562 6327 F. 02 9562 6350

01 SEP 2009

Mr Rick Bullers
Senior Archaeologist, AECOM
PO Box 726 Pymble
NSW 2073

Dear Mr Bullers

Re: Request - Search for Registered Aboriginal Owners

I refer to your letter dated 21 August 2009 regarding a proposed development of a gas pipeline between Young and Wagga Wagga, NSW.

I have searched the Register of Aboriginal Owners and the subject land does not appear to have Registered Aboriginal Owners pursuant to Division 3 of the *Aboriginal Land Rights Act* 1983 (NSW).

I trust that you are in contact with the Wagga Wagga and Young Local Aboriginal Land Council. They may also be able to assist you with information and contact details for other interested groups.

Yours sincerely

CField

Courtney Field
Administrative Officer
Office of the Registrar, *Aboriginal Land Rights Act* (1983)

31 August 2009

AECOM
PO Box 726 PYMBLE NSW 2073
T+61 2 8484 8999 F+61 2 8484 8989 www.aecom.com

Mr Stephen Free
Senior Aboriginal Heritage Officer/Archaeologist
Department of Environment, Climate Change and Water
PO Box 733
Queanbeyan NSW 2620

8 November 2009

Dear Stephen,

Re: Issues Raised by Mr Neville Williams in Regard to the Young to Wagga Wagga Looping Gas Pipeline Project

I refer to correspondence received from Mr Neville Williams dated 13 October 2009 and copied to the DECCW offices at Dubbo and Queanbeyan in relation to the above project (**Attachment A**).

The purpose of this letter is to provide clarification regarding the issues raised by Mr Williams and seek DECCW support for the conduct of the Aboriginal heritage assessment process.

Background

In August 2009 AECOM was commissioned by APA Group Pty Ltd (Eastern Australian Pipelines) to prepare an environmental assessment (EA) for the construction of a 130 km natural gas pipeline between Young and Bomen, near Wagga Wagga. The project is identified as a major project under Part 3A of the *Environmental Planning and Assessment Act 1979*. The proposed pipeline is to be constructed within an existing easement, where an existing natural gas pipeline was constructed in 1980. In addition, an underground optical fibre cable was installed in a large proportion of the easement in 2006. Consequently, the 20 m wide easement has been subject to two separate instances of disturbance including associated surface impacts and subsurface trenching.

The project has been divided into two stages:

- Stage 1: Wagga Wagga to Bethungra (approximately 50 km), currently undergoing assessment; and
- Stage 2: Bethungra to Young (approximately 80 km), to be assessed at a date to be determined.

As part of the EA process, and in accordance with the Director General's Requirements (DGRs) for the project, an Aboriginal heritage assessment was instigated to inform the EA. As a Part 3A project, the heritage assessment is being conducted in accordance with the draft *Part 3A EP&A Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC/DoP 2007). In accordance with those guidelines consultation with the Aboriginal community was instigated in accordance with the *Interim Community Consultation Guidelines for Applicant* (DEC 2004). A total of 21 Aboriginal stakeholders registered their interest in consultation, the majority of whom registered as individuals.

A methodology statement (**Attachment B**) was sent to all registered stakeholders identifying the method to be used for the assessment and, in particular, the use of a targeted survey to sample areas that held the greatest potential for retaining archaeological materials. As part of the methodology statement, registered stakeholders were asked to provide a response including any comments on the methodology and initial comments regarding the cultural (social) heritage values of the study area. In addition, they were asked to provide copies of their CVs and copies of appropriate insurance certificates including public liability and workers compensation.

As a result of the registration and consultation process, a total of ten groups/individuals were invited to take part in paid fieldwork for Stage 1 of the survey (the remaining stakeholders will be invited to take part in Stage 2). The majority of stakeholders in Stage 1 did not have their own insurances, but instead approached a labour hire company – Manpower – to provide the umbrella for employment. Negotiations with Manpower during early October 2009 established that each Aboriginal stakeholder employed on the project would be paid an hourly rate. Following lobbying by Mr Williams through Manpower, and additional payment was negotiated as payment towards living away from home expenses. Since each stakeholder was only engaged for two consecutive days, the living away from home payment was to cover expenses for a single night (between the two work days).

Consequently a field survey was conducted between 6 and 9 October 2009, with five Aboriginal stakeholders assisting on any one day. Mr Williams consistently queried the payment rates throughout his two days on the survey.

Issues

Mr William's correspondence of the 13 October raised three main issues:

1. Survey timing is incorrect resulting in missed sites;
2. No foot survey between transects; and
3. "Incorrect" payment rates.

1. Survey Timing; and

2. Survey Between Transects

AECOM believes that these two issues are directly related (in terms of methodology) and will be addressed jointly. The methodology clearly stated that the survey was to be conducted in a "targeted' fashion to sample areas that have the most potential for retaining archaeological material. It should be noted that there was never any intention to survey the whole route of the pipeline. The purpose of the survey was not to identify every Aboriginal site along the route. Rather, the purpose was to identify the patterning of Aboriginal use within the landscape traversed by the pipeline. To achieve this, a series of transects were identified based on topographic features of the survey route, AHIMS records of existing sites and previous archaeological reports to inform a predictive model of site occurrence for the study area. A total of 15 transects were walked on foot sampling a range of landform features including water courses, flats, terraces, slopes, ridges and hills crests, as well as re-identify any previously recorded sites within the easement.

Consequently, driving between identified transects was deemed to be the most suitable method. The Stage 1 survey identified a total of 31 Aboriginal sites either within or in close proximity to the pipeline easement. Of these, nine were previously recorded sites. Whilst a reasonably large proportion of the study area is currently under crop with zero visibility, a similarly large proportion of the study area was under pasture with reasonable levels of visibility. Further, whilst some areas that were intended to be surveyed (such as along minor drainage lines) could not be surveyed due to restrictions on access within the crops, our client has agreed that these areas may be surveyed towards the end of the year once those paddocks have been cleared of crops. A total of five transects are considered suitable for later survey.

Mr Williams was given the opportunity to comment on the survey methodology prior to the survey. He responded to the methodology statement on 26 September 2009, sending in a response form that supplied to him for that purpose. Mr Williams did not provide any comment or objection to the proposed methodology at that time (**Attachment C**).

Regardless, the primary aim of the survey was achieved. From the range of sites identified and landforms sampled, AECOM has identified a general model of site patterning within the study area, which will inform the likely impact assessment.

3. "Incorrect" Payment

This issue is a commercial arrangement between our clients and the Aboriginal stakeholders (mostly via labour hire company Manpower), and is not considered an issue for DECCW. However, these points are made for clarification. Firstly, there is no such thing as a "correct" payment. Mr Williams has consistently alluded to payments received on a previous project (Hume Highway project) and has based is assessment of the current payment terms on his previous experiences. Payment for Aboriginal field representatives is made on a project by project basis and, in fact, Manpower (who also provided Aboriginal stakeholders for the Hume Hwy project) confirmed prior to the current survey that the hourly rate paid for this survey was the same as for the Hume Hwy project. It appears that the inconsistency lies with the payment of the living away from home allowance. Each Aboriginal stakeholder was engaged for two consecutive days and, following lobbying by Mr Williams, a one of payment of $150 was offered to each representative to contribute to expenses for staying away from home the night between work days. It should be noted that payment of a living away from home allowance is not AECOM's normal practice and the offer was made in good faith.

The terms of engagement were provided to all participants prior to commencement of the survey. Participation in the survey is considered to be agreement with the terms offered.

Conclusion

AECOM believes that the methodology used in the Stage 1 survey is consistent with DECCW guidelines on Part 3A Aboriginal heritage assessment and Aboriginal community consultation. Further, AECOM proposes to continue with Stage 2 (date to be determined) in a similar fashion, with the exception that a pre-survey stakeholder meeting will be held to confirm all arrangements prior to survey.

AECOM seeks DECCW support for the proposed process and, in particular, for the response to the issues raised by Mr Williams. I would be happy to discuss the issues raised further if you wish. Please don't hesitate to contact the undersigned on 02 8484 8999.

Yours sincerely,

AECOM Australia Pty Ltd

Rick Bullers
Professional Archaeologist

Enclosures:

Attachment A

Attention

Rick Buller

Aboriginal Heritage Assessment Wagga to Young

Natural Gas Looping Pipeline, South-West Slopes NSW

4 Pages

From Neville Williams

Phone 0447841560

14/10/09

PO Box 70
COWRA NSW 2794

Phone/Fax (02) 6341 2604
Mobile: 0447 841 560

13 October 2009

Rick Bullers
Senior Archaeologist
AECOM
PO Box 728
PYMBLE NSW 2073

Dear Mr Bullers

Aboriginal Heritage Assessment—Wagga to Young Natural Gas Looping Pipeline, South-west Slopes NSW

On 6 and 7 October 2009 members of my family and I took part in an archaeological survey of a section—from Bethungra to past Junee—of the proposed Wagga to Young Natural Gas Looping Pipeline.

We believe that there were a number of deficiencies in the survey that need to be addressed.

First, the survey undertaken last week was carried out at the wrong time of the year because crops were covering most of the survey area and there was poor surface visibility. From our experience on other development projects, such surveys have been delayed until after crops were harvested and visibility increased substantially. Artefacts were found in these situations.

Second, no foot survey was undertaken between known Aboriginal sites as we drove from one known site to another. From previous experience we know that this type of method can easily miss Aboriginal sites that exist but have not yet been registered on the Department of Environment and Climate Change's Aboriginal Heritage Information Management System (AHIMS) that is far from comprehensive.

Another issue that we have about this project is the correct payment of rates, accommodation, living-away from-home, meals, mileage and incidental allowances.

My son, Wayne and I drove to Cootamundra from Cowra, where we are based, leaving Cowra at 5.00 am on 6 October 2009. Shawn and Sharon left their vehicles at Cootamundra and we used my vehicle for the whole of the field survey. We drove back to Cootamundra after we finished work on 7 October 2009. Sharon and Shawn were dropped off at the motel they were staying.

Wayne I drove back to Cowra that same evening after many hours of work as no accommodation costs were being met for us in Cootamundra for the evening of 7 October 2009. This meant that we were very tired when driving home which was a safety risk.

We are concerned that incorrect amounts for accommodation and allowances are being paid to us.

We believe that there should be a meeting held urgently (we suggest in Young) with all relevant Aboriginal stakeholders and representatives from AECOM and DECC to discuss such matters as:

- survey methodology and need for it to be redone on foot
- follow up to survey and the further involvement of Wiradjuri stakeholders and the use of Aboriginal monitors during construction
- working conditions including hours per day and OH&S
- payment of and rates of daily/hourly payments and allowances
- Any other relevant matters.

Your early reply to this letter would be appreciated.

Sincerely

Neville Williams

Copies to:

Young Local Aboriginal Land Council
DECC Cultural Heritage Division
PO A290 SOUTH SYDNEY NSW 1232

DECC Dubbo
DECC Queanbeyan

Manpower

AECOM

AECOM
PO Box 726 PYMBLE NSW 2073
T+61 2 8484 8999 F+61 2 8484 8989 www.aecom.com

Attachment B

Neville Williams

PO Box 70
Cowra NSW 2794

7 September 2009

Dear Neville,

Re: Aboriginal Heritage Assessment – Wagga Wagga to Young Natural Gas Looping Pipeline, South West Slopes, NSW - Methodology

ENSR Australia Pty Ltd (trading as AECOM and hereafter referred to as AECOM) has been commissioned to undertake an Aboriginal heritage assessment of the site of the proposed Natural Gas Looping Pipeline, between Wagga Wagga and Young, NSW (see attached figure). Thankyou for your recent registration of interest in this project.

As outlined in the Department of Environment, Climate Change and Water"s *Interim Community Consultation Requirements for Applicants* (DEC 2004), we are required to provide you with our proposed methodology for the project and allow 21 days to make comment.

Therefore, please find below AECOM's proposed methodology for investigation of these areas. Should you have comments upon the methodology, please contact Rick Bullers on 02 8484 8999. A response form is also attached for you to provide comments and/or endorsement of this project. This form is simply for your convenience and you are under no obligation to use it. Please note, if we receive all comments prior to the 21 days, the fieldwork can proceed sooner.

The investigation of the pipeline route will be conducted in two stages:

1. Stage 2(1): Wagga Wagga to Bethungra. This section encompasses approximately 50 km of the overall route; and
2. Stage 2(2): Bethungra to Young. This section includes the remaining length of the overall route (approximately 80 km).

At this stage, AECOM hopes to undertake the fieldwork for the first stage (Wagga Wagga to Bethungra) in the week commencing 28 September 2009 with your co-operation. Timing for the second stage will be advised at a later date.

Please also forward the following information:

- Details on public liability, workers compensation and professional indemnity insurances;
- Curriculum Vitae of participant from your group you are proposing to undertake the fieldwork;
- Recommended participant's demonstrated experience in undertaking survey work;
- Evidence or a statement of cultural knowledge that your organisation may possess; and
- Referees for the above skills.

Please note that there are likely to be places for up to six Aboriginal field representatives on any single day of the fieldwork. Due to the number of registered stakeholders for this project AECOM is proposing to develop a roster of stakeholder participation.

Important Note: registered stakeholders must provide copies of the insurances mentioned in the first dot point above. Unfortunately, organisations or individuals that cannot provide these insurances will be unable to take part in the field component of this assessment.

The comment period will close 21 days from the date of this letter.

For further enquiries or questions, please contact Rick Bullers on 02 8484 8999.

Yours faithfully,

ENSR Australia Pty Ltd (trading as AECOM)

Rick Bullers
Senior Archaeologist

Enclosures:

AECOM

AECOM
PO Box 726 PYMBLE NSW 2073
T +61 2 8484 8999 F +61 2 8484 8989 www.aecom.com

Methodology

This section provides general information on the approach AECOM intends to use for undertaking the Aboriginal heritage survey.

General Approach for Fieldwork

For this project, AECOM personnel will seek to investigate targeted areas of the pipeline route on foot. Each route will be walked by an archaeologist and the relevant stakeholders spaced between 5 and 10 m apart to ensure appropriate coverage. AECOM personnel have a finite time to investigate this area, one week, and will seek to methodologically investigate as much of the study area as possible in this time. We currently believe that all areas of the study area that have higher potential for retaining archaeological sites will be investigated within this timeframe.

A generalised map of the landforms of the pipeline route will by prepared. From this, areas of likely archaeological potential will be interpreted, including creeklines, ridgetops, hill tops and alluvial flats, and these will form the focus of targeted survey areas.

The survey will investigate any previously recorded Aboriginal sites in the study area and provide updated information for AHIMS. All previously unrecorded Aboriginal sites will be recorded (see below) and site cards will be prepared and submitted to DECCW.

Transects will focus on the 20 m wide easement of the pipeline route. However survey will extend to a width of 50 m either side of the pipeline route (i.e. 100 m wide in total) to a minimum distance of 100 m either side of a terrain feature such as a creekline or ridge crest. Where sites are identified, and the visible extent extends outside those survey areas, the entire site will still be recorded.

Recording of Terrain

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2 the probability of undetected surface archaeological materials;
3 the probability of subsurface archaeological materials; and
4 the terrain integrity of each transect area.

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- conditions for artefact detection (low, medium or high);
- effectiveness of surface survey (low, medium or high);
- availability of raw materials (present/absent);
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- presence of flaked stone artefacts (present/absent); and
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Following the fieldwork, a technical report will be prepared that describes the results of the survey, provides a significance assessment of Aboriginal sites identified, assesses the potential impact on the heritage values of the study area and provides management recommendations.

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Impacts to heritage values will be assessed based on the overall development footprint, the extent of individual sites and the significance of those sites.

A series of management recommendations will be prepared designed to minimise impacts to Aboriginal heritage values of the study area.

All comments received from the Aboriginal stakeholders will be incorporated into the final report.

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____

____

____

____

____

(Record your initial comments about the investigation above)

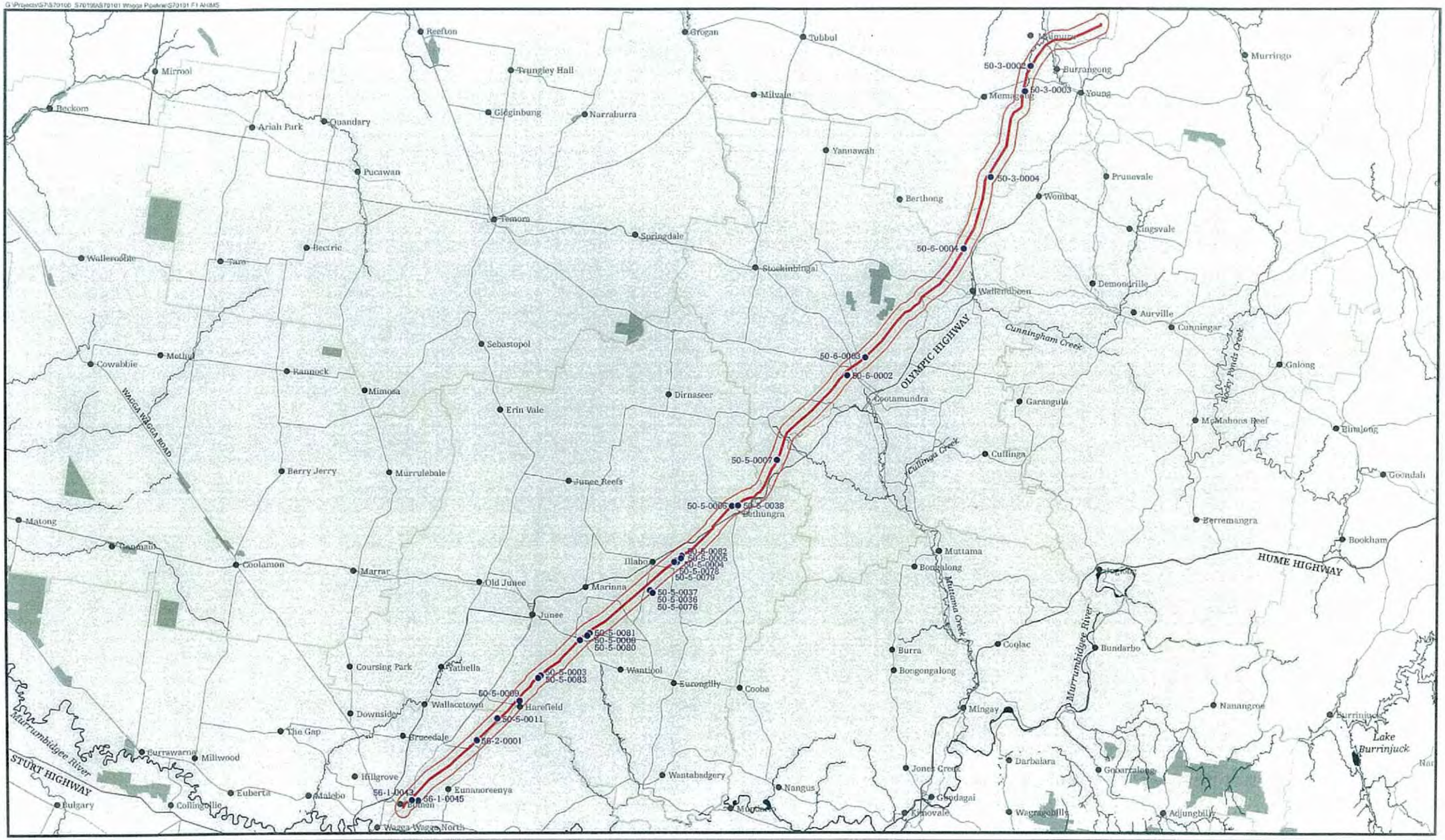
I understand that I have the opportunity to contact the undersigned at any stage of the project to discuss the cultural heritage values of the study area and will have the opportunity to review and provide further comment on receipt of the draft cultural heritage assessment report.

Name	
Organisation	
Position within Organisation	
Address	
Phone No.	
Fax No.	
Mobile No.	
Email	
Signature	

Please send this document signed back to **Rick Bullers** via:

- Fax : 02 8484 8989
- Post: PO Box 726, Pymble, NSW 2073
- E-mail: rickbullers@aecom.com

G:\Projects\S7\S70100_S70199\S70101 Wagga Pipeline\S70101 F1 AHIMS



	Proposed Pipeline Corridor
	Highway
	Road
	Railway
	State Forest
	Creek/River
•	AHIMS Site Location

0 15km

ENVIRONMENT

AECOM

PROJECT ID S70101
CREATED BY TO
LAST MODIFIED TO 03 09 2009

www.aecom.com

Site Location and AHIMS Site Search Results

APA Group Pty Ltd

Heritage Assessment: Young to Wagga Wagga Looping Pipeline

Young to Wagga Wagga, NSW

Figure

F1

Attachment C

Fax 02-84848989

Attention

Rick Bullers

Aboriginal Cultural Heritage Experience

And

Response form

8 pages

From

Neville Williams

26/9/09

Response Form

Aboriginal Heritage Assessment: Registration of Interest and Methodology

I have been sent information regarding the Aboriginal heritage investigation of the Natural gas Looping Pipeline Aboriginal Heritage Assessment between Wagga Wagga and Young, NSW. I seek to endorse the proposed methodology (unless otherwise stated below) and/or provide the following initial information I wish to be known regarding the cultural heritage values for the study area:

(Record your initial comments about the investigation above)

I understand that I have the opportunity to contact the undersigned at any stage of the project to discuss the cultural heritage values of the study area and will have the opportunity to review and provide further comment on receipt of the draft cultural heritage assessment report.

Name	NEVILLE WILLIAMS
Organisation	INDIVIDUAL STAKEHOLDER
Position within Organisation	ABORIGINAL SITES OFFICER SENIOR
Address	P O BOX 70 COWRA N S W 2794
Phone No.	0447641560
Fax No.	02-63412604
Mobile No.	
Email	
Signature	N Williams

26/9/09

Please send this document signed back to **Rick Bullers** via:

- Fax : 02 8484 8989
- Post: PO Box 726, Pymble, NSW 2073
- E-mail: rickbullers@aecom.com

ATTENTION

Rick Bullers

Senior Archaeologist

AECOM

PO Box 728

PYMBLE NSW 2073

25 January 2010

From

Neville Williams

FAX 02-63412604

PO Box 70
COWRA NSW 2794

Phone/Fax (02) 6341 2604
Mobile: 0447 841 560

24 January 2010

Rick Bullers
Senior Archaeologist
AECOM
PO Box 728
PYMBLE NSW 2073

Dear Mr Bullers

Draft Heritage Assessment—Young to Wagga Wagga Looping Gas Looping Pipeline (Stage 1), Bethungra to Wagga

I refer to your letter of 12 January 2010 and attached draft report on the Bethungra to Wagga stage of the Young to Wagga Looping Gas Pipeline.

There are a number of points I would like to make about the draft report.

Stakeholder Meetings
Stakeholder meetings are always essential parts of any other survey work we have undertaken or are doing on other projects. We believe that stakeholder meetings before and during survey work are essential to get to know each other, to discuss proposed the survey area, conditions and progress, proposed methodologies, to raise any other issues such as working conditions and rates of pay and to report back on our findings and views about how the work is going and if necessary, how it could be improved.

It is not correct to say that only one stakeholder asked for a meeting. We did so verbally and in our letter of 13 October 2009.

Could you please correct this inaccuracy in the draft report.

Comments on methodology
Archaeology is only one part of the Aboriginal heritage story. All Aboriginal archaeological sites are important to us. Also some areas may not have any archaeological record but are still highly significant for other reasons.

You would also know that there are some areas about which, for cultural reasons, we are not able to divulge any information.

We always prefer to advise archaeologists verbally about, and include our comments about proposed methodologies in letters, rather than fill out Response Forms, which are limited in how much information can be included.

Most archaeologists we work with do not use such forms anyway, understanding that Aboriginal culture is primarily an oral culture and that we are more comfortable with providing verbal advice. In some cases this might be recorded at stakeholder meetings on video or tape-recorded, in others by a note-taker, then the record of the meeting circulated to those who attended to make sure the record is correct. In our case we often follow up our verbal advice also with some kind of written confirmation such as a fax, email or letter.

Other archaeologists we work with also know that Aboriginal people make collective decisions through meetings rather than as individuals.

Also at the early stage before the survey began, when you sent us the Response Form to be completed, we had little idea about the survey route because you had not sent us any background information on which we could usefully comment.

We had hoped there would be a meeting of stakeholders before the survey work began where we could have also discussed the methodology and then followed the discussion up with written confirmation of our views if necessary. But as mentioned above we would have expected that a record of any stakeholder meeting would have been kept and circulated to those present for confirmation.

It is incorrect of Steve Free to say, in a reply to your letter to him of 8 November 2009, that I was mostly concerned about pay and conditions. This was only one of my concerns. I was then, and continue to be, concerned about the methodology used particularly because of the lack of visibility in a number of areas of the survey route.

Would you please therefore change your comments that we did not make any suggestions about the proposed methodology. They were indicated to you on the phone, included in our letter of 13 October 2009, and made known to you during the survey itself.

Management Commitment (Section 11.0)
While we understand that this is a project being undertaken under Part 3A of the Planning Act, this does not mean that Aboriginal cultural heritage should be treated as if it has little or no significance. As mentioned above, all Aboriginal Country has significance to us.

The archaeological remains of earlier Wiradjuri culture are fast disappearing. It cannot be replaced. We do not agree that most of the sites discovered so far along the proposed pipeline route are of 'low significance' and can be 'destroyed without salvage'.

No sub-surface work has been done on any of these sites to my knowledge. From experience we have found that sub-surface work often reveals substantial deposits of Aboriginal artefacts, which have been covered by layers of soil over the years.

Future action
A meeting needs to be held as soon as possible of all stakeholders, at a suitable central location, to discuss such issues as the draft report on this stage of the project, the methodology used so far and how it can be improved for the rest of the project,

cultural heritage management aspects of the first stage of and rest of the project, which areas will be revisited for further survey now that visibility may be better, undertaking sub-surface work, working conditions, monitoring by Aboriginal stakeholders during construction and any other issues that we and other stakeholders may wish to raise.

Should you wish to discuss these issues further, please contact me on mobile 0447 841 560.

Sincerely

Neville Williams on behalf of

Sharon Williams
Shawn Williams
Wayne Williams

Appendix D

Methodology Statement

"This page has been left blank intentionally"

AECOM
PO Box 726 PYMBLE NSW 2073
T+61 2 8484 8999 F+61 2 8484 8989 www.aecom.com

«First_Name» «Last_Name»
«Organisation»
«Address_1»
«Address_2»

7 September 2009

Dear «First_Name»,

Re: Aboriginal Heritage Assessment – Wagga Wagga to Young Natural Gas Looping Pipeline, South West Slopes, NSW - Methodology

ENSR Australia Pty Ltd (trading as AECOM and hereafter referred to as AECOM) has been commissioned to undertake an Aboriginal heritage assessment of the site of the proposed Natural Gas Looping Pipeline, between Wagga Wagga and Young, NSW (see attached figure). Thankyou for your recent registration of interest in this project.

As outlined in the Department of Environment, Climate Change and Water''s *Interim Community Consultation Requirements for Applicants* (DEC 2004), we are required to provide you with our proposed methodology for the project and allow 21 days to make comment.

Therefore, please find below AECOM's proposed methodology for investigation of these areas. Should you have comments upon the methodology, please contact Rick Bullers on 02 8484 8999. A response form is also attached for you to provide comments and/or endorsement of this project. This form is simply for your convenience and you are under no obligation to use it. Please note, if we receive all comments prior to the 21 days, the fieldwork can proceed sooner.

The investigation of the pipeline route will be conducted in two stages:

1. Stage 2(1): Wagga Wagga to Bethungra. This section encompasses approximately 50 km of the overall route; and
2. Stage 2(2): Bethungra to Young. This section includes the remaining length of the overall route (approximately 80 km).

At this stage, AECOM hopes to undertake the fieldwork for the first stage (Wagga Wagga to Bethungra) in the week commencing 28 September 2009 with your co-operation. Timing for the second stage will be advised at a later date.

Please also forward the following information:

- Details on public liability, workers compensation and professional indemnity insurances;
- Curriculum Vitae of participant from your group you are proposing to undertake the fieldwork;
- Recommended participant's demonstrated experience in undertaking survey work;
- Evidence or a statement of cultural knowledge that your organisation may possess; and
- Referees for the above skills.

Please note that there are likely to be places for up to six Aboriginal field representatives on any single day of the fieldwork. Due to the number of registered stakeholders for this project AECOM is proposing to develop a roster of stakeholder participation.

Important Note: registered stakeholders must provide copies of the insurances mentioned in the first dot point above. Unfortunately, organisations or individuals that cannot provide these insurances will be unable to take part in the field component of this assessment.

The comment period will close 21 days from the date of this letter.

For further enquiries or questions, please contact Rick Bullers on 02 8484 8999.

Yours faithfully,

ENSR Australia Pty Ltd (trading as AECOM)

Rick Bullers
Senior Archaeologist

Enclosures**:**

AECOM
PO Box 726 PYMBLE NSW 2073
T+61 2 8484 8999 F+61 2 8484 8989 www.aecom.com

Methodology

This section provides general information on the approach AECOM intends to use for undertaking the Aboriginal heritage survey.

General Approach for Fieldwork

For this project, AECOM personnel will seek to investigate targeted areas of the pipeline route on foot. Each route will be walked by an archaeologist and the relevant stakeholders spaced between 5 and 10 m apart to ensure appropriate coverage. AECOM personnel have a finite time to investigate this area, one week, and will seek to methodologically investigate as much of the study area as possible in this time. We currently believe that all areas of the study area that have higher potential for retaining archaeological sites will be investigated within this timeframe.

A generalised map of the landforms of the pipeline route will by prepared. From this, areas of likely archaeological potential will be interpreted, including creeklines, ridgetops, hill tops and alluvial flats, and these will form the focus of targeted survey areas.

The survey will investigate any previously recorded Aboriginal sites in the study area and provide updated information for AHIMS. All previously unrecorded Aboriginal sites will be recorded (see below) and site cards will be prepared and submitted to DECCW.

Transects will focus on the 20 m wide easement of the pipeline route. However survey will extend to a width of 50 m either side of the pipeline route (i.e. 100 m wide in total) to a minimum distance of 100 m either side of a terrain feature such as a creekline or ridge crest. Where sites are identified, and the visible extent extends outside those survey areas, the entire site will still be recorded.

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Name	
Organisation	
Position within Organisation	
Address	
Phone No.	
Fax No.	
Mobile No.	
Email	
Signature	

Please send this document signed back to **Rick Bullers** via:

- Fax : 02 8484 8989
- Post: PO Box 726, Pymble, NSW 2073
- E-mail: rickbullers@aecom.com

Worldwide Locations

Australia	+61-2-8484-8999
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Belgium	+32-3-540-95-86
Bolivia	+591-3-354-8564
Brazil	+55-21-3526-8160
China	+86-20-8130-3737
England	+44 1928-726006
France	+33(0)1 48 42 59 53
Germany	+49-631-341-13-62
Ireland	+353 1631 9356
Italy	+39-02-3180 77 1
Japan	+813-3541 5926
Malaysia	+603-7725-0380
Netherlands	+31 10 2120 744
Philippines	+632 910 6226
Scotland	+44 (0) 1224-624624
Singapore	+65 6295 5752
Thailand	+662 642 6161
Turkey	+90-312-428-3667
United States	+1 978-589-3200
Venezuela	+58-212-762-63 39

Australian Locations

Adelaide
Brisbane
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Appendix F

Preliminary Hazard Analysis

PRELIMINARY HAZARD ANALYSIS OF THE NATURAL GAS DELIVERY PIPELINE BETWEEN YOUNG AND BOMEN IN NSW

Prepared for: APA Group

Document Number: APAGRO\08-B196

Revision B

Prepared by: Karin Nilsson

13 October 2009

PO Box 248
Berowra Heights NSW 2082
Telephone: [02] 9985 1056
Facsimile: [02] 9427 7851
Email: Planager@bigpond.net.au

PLANAGER
Risk Management Consulting

Preliminary Hazard Analysis of the Natural Gas Delivery Pipeline between Young and Bomen in NSW

Acknowledgment

The author would like to thank Prakash Mehta for his assistance in preparing this report.

Disclaimer

This report was prepared by Planager Pty Ltd (Planager) as an account of work for the APA Group. The material in it reflects Planager's best judgement in the light of the information available to it at the time of preparation. However, as Planager cannot control the conditions under which this report may be used, Planager and its related corporations will not be responsible for damages of any nature resulting from use of or reliance upon this report. Planager's responsibility for advice given is subject to the terms of engagement with APA Group.

Rev	Date	Description	Prepared By	Authorised By
A	15/10/2009	Draft for Comment	Karin Nilsson	Prakash Mehta
B	13/10/2009	Final Report	Karin Nilsson	Prakash Mehta

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EXECUTIVE SUMMARY

E1 Introduction

To meet the rising demand for natural gas to the towns in the central south of NSW and to a new power station at Uranquinty, the East Australian Pipeline Pty Ltd (EAPL), a wholly owned subsidiary of APA Group, is proposing to loop the existing 12” Young to Bomen pipeline with an 18” pipeline which would run parallel to the existing pipeline.

Due to the potentially hazardous nature of natural gas, the pipeline is classified as *potentially hazardous* as per the definition by the NSW Department of Planning.

As one element of the planning approval process, the NSW Department of Planning requires a Preliminary Hazard Analysis (PHA) to be prepared in accordance with the requirements of Hazardous Industry Planning Advisory Paper (HIPAP) No. 6: *Guidelines for Hazard Analysis* (Reference 1) and for the risk to be evaluated and compared with their risk criteria, as specified in their HIPAP No. 4: *Risk Criteria for Landuse Planning* (Reference 2).

The aim of this PHA is to ensure that there are no constraints, from a risk point of view, to the location of the new 18” pipeline alongside the existing pipeline.

The objective of this PHA is to present hazards and risks associated with the natural gas pipeline from the point where the pipeline leaves the compressor station at Young up to the point where the pipeline enters the metering station at Bowmen.

The PHA will:

- identify and analyse the acute hazards and risks associated with the pipeline;
- assess the findings against the risk criteria currently in use by NSW Department of Planning; and
- identify opportunities for risk reduction, and make recommendations as appropriate.

The methodology for the PHA is well established in NSW. The assessment has been carried as per the Hazardous Industry Advisory Paper (HIPAP) No 4, Risk Criteria for Land Use Planning and in accordance with HIPAP No 6, Guidelines for Hazard Analysis. These documents describe the methodology and the criteria to be used in PHAs as currently required by Planning NSW for major *potentially hazardous* development.

E2 Results

The main hazard associated with the gas pipeline is associated with the transport of natural gas, which is a flammable gas held under pressure.

The failure modes assessed in the PHA are derived from historical failures of similar pipelines. The predominant mode in which a hazardous incident may be generated is associated with a rupture or leak.

A leak would generally only have the potential to cause injury or damage if there was ignition, which resulted in a fire or explosion incident. The factors involved are:

- Failure must occur causing a release. There are several possible causes of failure, with the main ones being corrosion and damage to the pipeline by external agencies.

- The released material must come into contact with a source of ignition. In some cases this may be heat or sparks generated by mechanical damage while in others, the possible ignition source could include non-flame proof equipment, vehicles, or flames some distance from the release.

- Depending on the release conditions, including the mass of material involved and how rapidly it is ignited, the results may be a localised fire (for example, a so called jet fire) or a flash fire. Due to the open layout of the area surrounding the pipeline, an explosion of the vapour cloud formed through the release is considered highly unlikely.

- Finally, for there to be a risk, people must be present within the harmful range (consequence distance) of the fire or explosion. How close the people are will determine whether any injuries or fatalities result.

E3 Risk Assessment and Conclusions

The qualitative and quantitative analysis showed that:

- The risk of fatality at the nearest residential area is well below the criterion for new installations of one chance in a million per year (1×10^{-6}/yr) and remains within the pipeline easement.

- It follows that the 10×10^{-6} per year fatality risk contour (relevant for open spaces) remains well within the pipeline easement and does not encroach into any open spaces. The criterion for open spaces is therefore satisfied.

- It also follows that the 50×10^{-6} per year fatality risk contour (relevant for industry and business) remains well within the pipeline easement and does not encroach into any business or industrial zones. The criterion for industrial and business zoning is therefore satisfied.

- The 50 x 10^{-6} per year injury and propagation risk contours remain well within the pipeline easement. The criteria for injury and propagation risks are therefore satisfied.

As the risk of fatality does not extend anywhere outside the boundaries, it is considered that the proposed development does not have a significant impact on societal risk.

GLOSSARY

APT	Australian Pipelines Trust
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HIPAP	Hazardous Industry Planning Advisory Paper
HSE	Health and Safety Executive (UK)
LFL	Lower Flammable Limit
MAOP	Maximum Allowable Operating Pressure
MPa	Mega Pascal (unit for pressure)
MSDS	Material Safety Data Sheet
MW	Mega Watt (unit for energy output)
NG	Natural gas
OH&S	Occupational Health and Safety
PHA	Preliminary Hazard Analysis
QRA	Quantitative Risk Analysis
SCADA	Supervisory Control and Data Acquisition

REPORT

1 INTRODUCTION

1.1 BACKGROUND

To meet the rising demand for natural gas the towns in the central south of NSW and to a new power station at Uranquinty, the East Australian Pipeline Pty Ltd (EAPL), a wholly owned subsidiary of APA Group, is proposing to loop the existing 12” Young to Bomen Pipeline with an 18” Pipeline which would run parallel to the existing pipeline.

Due to the potentially hazardous nature of natural gas, the pipeline is classified as *potentially hazardous* as per the definition by the NSW Department of Planning.

As one element of the planning approval process, the NSW Department of Planning requires a Preliminary Hazard Analysis (PHA) to be prepared in accordance with the requirements of Hazardous Industry Planning Advisory Paper (HIPAP) No. 6: *Guidelines for Hazard Analysis* (Reference 3) and for the risk to be evaluated and compared with their risk criteria, as specified in their HIPAP No. 4: *Risk Criteria for Landuse Planning* (Reference 4).

This document presents the PHA of the natural gas pipeline and forms an appendix to the Environmental Assessment for this pipeline.

1.2 SCOPE AND AIM OF STUDY

The aim of this PHA is to ensure that there are no constraints, from a risk point of view, to the location of the proposed new main gas line between Young and Bomen.

The objective of this PHA is to present the hazards and risks associated with the natural gas pipeline from the Bomen Meter Station up to the entrance to the Young Compressor Station.

Through the evaluation of likelihood and consequence of the major hazards, the risks to the community associated with proposed gas pipeline may be estimated and compared to Department of Planning risk criteria.

The pipeline included in this PHA includes all pipe and associated features:

- From the point where the pipeline leaves the compressor station at Young;

- Up to the point where the pipeline enters the metering station at Bowmen.

The PHA does not assess the risk associated with any pipe downstream of the meter station or the meter station itself at Bowmen, nor does it include the Young compressor station or any pipe upstream of the compressor station.

The scope of this report includes the following:

- Systematic identification and documentation of the major hazards, based on the information supplied and relevant experience with similar pipelines.

- Establishment of the consequence of each identified hazard and determination as to their offsite effects. This process is generally qualitative, with relevant quantitative calculations/modelling being completed where necessary.

- The frequency of occurrence is estimated based on historical data. If such data is unavailable, assumptions and qualitative discussions are presented.

- Determination of the acceptability (or otherwise) risk by comparison of the qualitative or quantitative assessment of the identified risks with the criteria specified in the NSW Department of Planning HIPAP No. 4 (Reference 4).

- Identification of risk reduction measures as deemed necessary.

At the time this PHA was conducted, design of the gas pipeline was in its preliminary stages. Detailed information was therefore not available for review. In situations where such information could impact on the PHA, assumptions have been made. These assumptions are intentionally conservative and have been stated in the report.

As a result of this conservatism, the results of the PHA are also inherently conservative, and this should be noted in their interpretation and application beyond the scope of this work.

2 SITE AND PROCESS DESCRIPTION

2.1 SITE LOCATION AND SURROUNDING LAND USES

The proposed pipeline will run south west from the Young Compressor Station towards the Bowmen Meter Station. Initially only part of the pipeline will be constructed, the length required being determined through consultation with the gas users.

The existing pipeline is bi-directional also enabling Moomba gas from South Australia to flow to Victoria and Bass Strait gas from Longford to flow to Sydney. The new (parallel) pipeline will also be bi-directional.

The pipeline route traverses the Young, Cootamundra, Harden and Junee Shire Council areas in NSW. The area is predominantly used for grazing and cropping.

The pipeline will be entirely located inside the existing easement. The pipeline construction will require a working width slightly wider than the easement.

The relevant Local Environmental Plans and Regional Planning Instruments associated with the proposed pipeline route include the:

- Young Local Environmental Plan
- Cootamundra Shire Local Environmental Plan
- Harden Shire Local Environmental Plan
- Junee Shire Local Environmental Plan
- Wagga Wagga Local Environmental Plan
- Western New South Wales Regional Environmental Plan.

Figure 1 – Corridor for Pipeline Route

2.2 DESIGN AND OPERATION

The pipeline would be a buried class 600, steel pipe with a proposed maximum allowable operating pressure 10.2MPa.

The pipeline would be designed and built to AS2885 (Reference 5), *Pipelines Gas and Liquid Petroleum*.

The assumptions as to the technical details made for the pipeline in this PHA are given in Table 1 below, and further in the listing below the table.

Table 1 – Summary of Preliminary Assumptions Made in the PHA for the Pipeline Design

Item	**Pipeline Design**
Percent operational	All data used in the present risk assessment are for a pipeline pressurised 100% of the time.
Pipe Diameter	450 mm NB (nominal bore)
Pipe Length	130 kilometre
Maximum Allowable Operating Pressure (MAOP)	10.2 MPa, ANSI Class 600
Actual operating pressure	8.5 MPa
Temperature	25^{o}C
Class Location to AS2885	R1 (broadly rural) with 40 hectare blocks with some R2 (rural residential) as per AS2885 definitions.
Pipe Thickness	6.8 mm to 9.7mm
Depth of Cover	At least 900mm (or 450mm in rock if encountered)
Number of flanges	5 flange joints per mainline valve (MLV) with four MLVs along the pipeline.
Features	Pressure indication and Actuator Line Break (ALB) on each MLV.
Design Standard	As per AS2885 requirements

The ALB feature is associated with emergency isolation of the pipeline. All MLVs are fitted with ALBs. The ALB allows a drop in line pressure to be quickly ascertained.

For the purposes of the present risk assessment, closure of the MLV using ALB system in case of a major leak is assumed to be able to be triggered automatically by a sudden drop of pressure or manually by the operator in the control room. The SCADA system, which includes telemetered data from the valve stations instrumentation, would give the operator sufficient details upon which to make a decision to close the valve.

2.3 OPERATING HOURS AND STAFFING

The gas pipeline would be pressurised 100% of the time.

2.4 SECURITY

The gas pipeline would be buried. MLVs along the pipeline would be surrounded by security fence. Any buildings associated with MLVs would have intruder detection fitted on the doors which would be telemetered to the Young Control Room.

3 STUDY METHODOLOGY

3.1 INTRODUCTION

The methodology for the PHA is well established in Australia. The assessment has been carried as per the Department of Planning's HIPAP No 6 (*Guidelines for Hazard Analysis*, Reference 3) and HIPAP No 4 (*Risk Criteria for Land Use Planning*, Reference 3). These documents describe the methodology and the criteria to be used in PHAs, as required by the Department of Planning for major "potentially hazardous" development.

There are five stages in risk assessment (as per Reference 3):

Stage 1. Hazard Identification: The hazard identification includes a review of potential hazards associated with the pipeline. The hazard identification includes a comprehensive identification of possible causes of potential incidents and their consequences to public safety and the environment, as well as an outline of the proposed operational and organisational safety controls required to mitigate the likelihood of the hazardous events from occurring.

The tasks involved in the hazard identification of the proposed gas pipeline included a review of all relevant data and information to highlight specific areas of potential concern and points of discussion, including drafting up of preliminary hazard identification word diagram. The review takes into account both random and systematic errors, and gives emphasis not only to technical requirements, but also to the management of the safety activities and the competence of people involved in them. This step was undertaken as a desktop exercise only. The hazard identification word diagram is presented in Section 4.3.

Stage 2. Consequence and Effect Analysis: The consequences of identified hazards are assessed using current techniques for risk assessment. Well established and recognised correlations between exposure and effect on people are used to calculate impacts.

Stage 3. Frequency Analysis: For incidents with significant effects, whether on people, property or the biophysical environment, the incident frequency are estimated, based on historical data. A probabilistic approach to the failure of pipes is used to develop frequency data on potentially hazardous incidents.

Stage 4. Quantitative Risk Analysis: The combination of the probability of an outcome, such as injury or death, combined with the frequency of an event gives the risk from the event. In order to assess the merit of the proposal, it is necessary to calculate the risk at a number of locations so that the overall impact can be assessed. The risk for each incident is calculated according to:

Risk = Consequence x Frequency

Total risk is obtained by adding together the results from the risk calculations for each incident, i.e. the total risk is the sum of the risk calculated for each scenario.

The results of the risk analysis are presented in four forms:

- Individual Fatality Risk, i.e. the likelihood (or frequency) of fatality to notional individuals at locations around the site, as a result of any of the postulated fire and explosion events. The units for individual risk are probability (of fatality) per million per year. Typically, the result of individual risk calculation for a gas pipeline is shown in the form of a risk transect.

- Injury risk, i.e. the likelihood of injury to individuals at locations around the pipeline as a result of the same scenarios used to calculate individual fatality risk.

- Propagation risk, i.e. the likelihood that an incident at the pipeline propagates to industrial areas in the vicinity.

- Societal risk takes into account the number of people exposed to risk. Whereas individual risk is concerned with the risk of fatality to a (notional) person at a particular location (person 'most at risk', i.e. outdoors), societal risk considers the likelihood of actual fatalities among any of the people exposed to the hazard. Societal risk are presented as so called *f-N curves*, showing the frequency of events (f) resulting in N or more fatalities. To determine societal risk, it is necessary to quantify the population within each zone of risk surrounding a facility. By combining the risk results with the population data, a societal risk curve can be produced.

The risk results are then assessed against the guidelines adopted by the Department of Planning (Reference 4).

Stage 5. Risk reduction: Where possible, risk reduction measures are identified throughout the course of the study in the form of recommendations.

3.2 RISK CRITERIA

Having determined the risk from a development, it must then be compared with accepted criteria in order to assess whether or not the risk level is tolerable. If not, specific measures must be taken to reduce the risk to a tolerable level. Where this is not possible, it must then be concluded that the proposed development is not compatible with the existing surrounding land uses.

3.2.1 Individual Risk Criteria

The individual fatality risk is the probability of fatality to a person or a facility at a particular point. It is usually expressed as chances per million per year (pmpy). It is assumed that the person would be at the point of interest 24 hours per day for the whole year. By convention in NSW, no mitigation is allowed, i.e. any possible evasive action that could be taken by a person exposed to a hazardous event, e.g. by walking out of a toxic cloud or a heat radiation. The assessment of fatality, incident propagation and injury risk should include all components contributing to the total risk, i.e. fire and explosion.

The Department of Planning uses a set of guidelines on acceptable levels or individual risk which are in line with the criteria used elsewhere in the world. These guidelines are published in the Hazardous Industry Planning Advisory Paper No. 4: *Risk Criteria for Land Use Safety Planning* (Reference 4). The criteria for maximum tolerable individual risk from a new development are shown in Table 2 below. The criteria have been chosen so as not to impose a risk which is significant when compared to the background risk we are already exposed to. This table shows the criteria for individual risk of fatality, injury and propagation of an incident.

Table 2 – Criteria for Tolerable Individual Risk from a New Development

Land Use		Maximum Tolerable Risk (pmpy[1])
Fatality risk criteria:		
Hospitals, Schools, etc		0.5
Residential areas, hotels, etc		**1**
Offices, retail centres, etc		5
Open space, recreation areas etc		10
Neighbouring industrial areas		50
Overpressure for Safety Distances:		
Property damage and accident propagation	14 kPa	50 Adjacent potentially hazardous installation, land zoned to accommodate such installations, or nearest public building
Injury risk levels	7 kPa	50 At residential areas
Maximum Heat Radiation:		
Injury risk levels	4.7 kW/m^2	50 At residential areas
Property damage and accident propagation	23 kW/m^2	50 Adjacent potentially hazardous installation or land zoned to accommodate such installations

In order to put these risks into perspective, published information on the level of risk to which each of us may be exposed from day to day due to a variety of activities has been shown in Table 3 below. Some of these are voluntary, for which we may accept a higher level of risk due to a perceived benefit, while some are involuntary. Generally, we tend to expect a lower level of imposed or involuntary risk especially if we do not perceive a direct benefit.

Table 3 – Risk to Individuals

Activity / Type of Risk	Published levels of risk (pmpy[1])
VOLUNTARY RISKS (AVERAGED OVER ACTIVE PARTICIPANTS)	
Smoking	5,000
Drinking alcohol	380
Swimming	50
Playing rugby	30
Travelling by car	145
Travelling by train	30
Travelling by aeroplane	10
INVOLUNTARY RISKS (AVERAGED OVER WHOLE POPULATION)	
Cancer	1,800
Accidents at home	110
Struck by motor vehicle	35
Fires	10
Electrocution (non industrial)	3
Falling objects	3
Storms and floods	0.2
Lightning strikes	0.1

3.2.2 Societal Risk Criteria

Societal risk is concerned with the potential for an incident to coincide in time and space with a human population. Societal risk takes into account the potential for an incident to cause multiple fatalities. Therefore, two components are relevant, namely:

- the number of people exposed in an incident; and
- the frequency of exposing a particular number of people.

In the absence of published criteria in HIPAP 4 (Reference 4), the criteria in the 1996 regional study of Port Botany by the Department of Planning[2] have been used for indicative purposes, as presented in Table 4 below.

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[1] pmpy = per million per year

[2] then the Department of Urban Affairs and Planning

Table 4 - Criteria for Tolerable Societal Risk

Number of fatalities (N) [-]	Acceptable limit of N or more fatalities per year	Unacceptable limit of N or more fatalities per year
1	3×10^{-5}	3×10^{-3}
10	1×10^{-6}	1×10^{-4}
100	3×10^{-8}	3×10^{-6}
1000	1×10^{-9}	1×10^{-7}

The societal risk criteria specify levels of societal risk which must not be exceeded by a particular activity. The same criteria are currently used for existing and new developments. Two societal risk criteria are used, defining acceptable and unacceptable levels of risk due to a particular activity. The criteria in Table 4 above are represented on the societal risk (f-N) curve as two parallel lines. Three zones are thus defined:

- Above the unacceptable/intolerable limit the societal risk is not acceptable whatever the perceived benefits of the development.
- The area between the unacceptable and the acceptable limits is known as the ALARP (as low as reasonably possible) region. Risk reduction may be required for potential incidents in this area.
- Below the acceptable limit, the societal risk level is negligible regardless of the perceived value of the activity.

3.3 Risk Calculations

In order to determine the cumulative risk from all identified hazards, a series of spreadsheets were used. The computer software tool ISORIS from the Warren Centre for Advanced Engineering (Ref 6) was also used as a back-up to control the output from the spreadsheet calculations. First, base information on the incidents, including type, location, processing conditions and frequency were entered into a spreadsheet. This spreadsheet calculates the leak rate for each incident using standard orifice flow equations for vapour or liquid, as appropriate. The spreadsheet also determines the base consequences for each incident in terms of total radiant heat release rate and TNT equivalent. See Appendix 1 for a printout of the incident listing from the spreadsheet.

3.4 Safety Management Systems

3.4.1 Safety Management in General

In quantitative risk assessments, incidents are assessed in terms of consequences and frequencies, leading to a measure of risk. Where possible, frequency data used in the analysis comes from actual experience, e.g. near misses or actual incidents. However, in many cases, the frequencies used are generic, based on historical information from a variety of facilities and processes with different standards and designs.

As with any sample of a population, the quality of the management systems (referred to here as "safety software") in place in these historical facilities will vary. Some will have little or no software, such as work permits, planned maintenance and modification procedures, in place. Others will have exemplary systems covering all issues of safe operation. Clearly, the generic frequencies derived from a wide sample represent the failure rates of an "average facility". This hypothetical average facility would have average hardware and software safety systems in place.

If an installation which has significantly below average safety software in place is assessed using the generic frequencies, it is likely that the risk will be underestimated. Conversely, if a facility is significantly above average, the risk will probably be overestimated. However, it is extremely difficult to quantify the effect of software on facility safety. Incorporating safety software as a means of mitigation has the potential to significantly reduce the frequency of incidents and also their consequences if rigorously developed and applied. The risk could also be underestimated if safety software is factored into the risk assessment but is not properly implemented in practice. Practical issues also arise when attempting to factor safety software into the risk assessment – applying a factor to the overall risk results could easily be misleading as in practice it may be the failure of one aspect of the safety software that causes the accident, while all other aspects are managed exemplarily.

In this study it is assumed that the generic failure frequencies used apply to installations, which have safety software corresponding to accepted industry practice and that this site has similar management practices and systems. This assumption it is believed, will be conservative in that it will overstate the risk from well managed installations.

3.4.2 Audits of Safety Management System

As per the requirements by the Department of Water and Energy, yearly audits are carried out of the Safety and Operating Plan for then pipelines under the responsibility of the APA Group. This new pipeline is no different to existing pipelines.

4 HAZARD IDENTIFICATION

4.1 HAZARDOUS MATERIALS

The gas may be sourced either from the Moomba in South Australia or from Victoria. The composition of natural gas is shown in Table 5. Natural gas is composed predominantly of methane gas.

Table 5 – Composition of Natural Gas

Component	**South Australia** **Mole %**	**Victoria** **Mole %**
methane	95.73	88.9
ethane	2.02	6.79
propane	0.47	0.47
n-butane	0	0.03
n-pentane	0	0
i-pentane	0	0
hexane	0	0
nitrogen	1.23	0.56
carbon dioxide	0.91	3.17
TOTAL	**100**	**100**

The properties of methane gas are presented in Table 6 below.

Table 6 - Properties of Methane Gas

Molecular weight (g/mol)	17
Relative density of the gas (atmospheric temp. and pressure)	0.6
Heat of combustion (MJ/kg)	50
Flammable range (vol. % in air)	5 to 15
Ratio of specific heats (Cp + Cv)	1.31
Flash point	-218^{o}C

4.2 Summary of Hazards Identified

A total of 10 potentially hazardous scenarios were identified for the gas pipeline, as listed in Table 7 below. The *Hazard Identification Word Diagram* in Table 8 details these hazards, their potential initiating events as well as their proposed controls.

Table 7 - Summary of Identified Hazards

Number	Hazardous Event Potential
1	Mechanical damage to the pipeline
2	Corrosion
3	Nearby explosion at neighbouring natural gas pipeline
4	Pressure excursion
5	Spontaneous loss of integrity of pipe (rupture)
6	Erosion
7	Land subsidence
8	Aircraft, train or heavy vehicle crash
9	Damage to pipeline through terrorism / vandalism
10	Neighbouring bush fire

A leak of flammable natural gas would generally only have the potential to cause injury or damage if there was ignition, which resulted in a fire or (in case of confinement) an explosion incident. The factors involved are:

- The pipeline must fail in a particular mode causing a release. There are several possible causes of failure, with the main ones being corrosion and damage by external agencies.

- The released material must come into contact with a source of ignition. In some cases this may be heat or sparks generated by mechanical damage while in others, the possible ignition source could include non-flame proof equipment, vehicles, or flames some distance from the release.

- Depending on the release conditions, including the mass of flammable material involved and how rapidly it ignited, the results may be a localised fire (for example a jet fire), a flash fire or an explosion of the vapour cloud formed through the release.

- Finally, for there to be a risk, people must be present within the harmful range (consequence distance) of the fire or explosion. How close the people are will determine whether any injuries or fatalities result.

Environmental damage from gas fire incidents are generally associated with a failure to control fire water used.

Natural gas is a buoyant, flammable gas which is lighter than air (relative density of 0.6). On release into the open the non-ignited gas tends to disperse rapidly at altitude. Ignition at the point of release is possible, in which case the gas would burn as a jet (or torch) flame. On release in an enclosed area an explosion or a flash fire is possible.

The gas is non-toxic, posing only an asphyxiation hazard. Due to its buoyancy, any release of credible proportions from operations of this scale, in the open, would not present an asphyxiation hazard. With standard confined space entry procedures and appropriate security arrangements to prevent unauthorised access to any of the facilities the risk associated with asphyxiation from natural gas should be minimal.

Locally, the pressure of the compressed gas may be hazardous in case of an uncontrolled release. These hazards, while of importance for people working with the gas pipeline, do not have implications beyond the immediate location of the release unless the released gas is ignited. Therefore, the risk associated with of non-ignited compressed gas does not form part of the scope of the present risk assessment. This potential risk would, however, need to be closely managed through job safety analysis (JSA) and/or other risk assessment practices used by management and maintenance workers (in accordance with NSW Occupational Health and Safety Act and its associated legislation (Reference 7)).

4.3 HAZARD IDENTIFICATION WORD DIAGRAM

The Hazard Identification Word Diagram, included in Table 8 below, provides a summary of the hazardous incidents identified for the proposed pipeline and their associated mitigating features.

While the table below provides an overview of the preventative and protective features proposed and recommended for the site, these safeguards are further detailed in Section 5.2.

Table 8 – Hazard Identification Word Diagram

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
SECTION OF FACILITY: Natural Gas pipeline			
1. Mechanical impact on the pipeline causes leak of natural gas from the pipeline.	3rd party involvement e.g. digging or trenching, or other earth work. 1st party involvement. Non through wall damage, i.e. part wall or delayed failure damage.	Massive release of natural gas (NG). If ignition, then possibility of flash or jet fire. Physical explosion from the pressure of the pipeline creates projectiles (earth, sand, stones). Injury and property damage.	- Buried pipeline to AS2885 requirements. - Rural zoning. Mainly large farming developments with some smaller lots. - Signage along pipe route, including Dial-Before-You-Dig information. Drawings available to Dial-Before-You-Dig. Pipeline route within easement. - Resistance of pipelines to penetration through use of pipe thickness and adequate design factor as per AS2885. - MLV stations will be clearly marked and surrounded by security fencing. All pipes and valves are of robust design and construction. - Automatic shut down through automatic line break detection and valve closure if large hole in pipe. Manual shut down by Network Controller in Control Centre in Young if pressure drop. - NG disperses readily upwards, minimising chances of ignition. Explosion not credible in unconfined situation.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
2. Corrosion leads to leak of natural gas from the gas pipeline.	Damage of pipeline coating due to excavation inspection damage leads to corrosion. Construction damage or coating flaw or faulty materials	Release of gas. If ignition, a jet fire is possible. Injury and property damage.	- Cathodic protection for external corrosion. Internal corrosion virtually absent with clean hydrocarbon. - Coating on external surfaces of pipelines. - Routine inspection of pipeline (including regular patrol and pigging). Visual and sound indications if leak. - Pipeline to be constructed to facilitate internal (pigging) inspection (minimise dips). - Cathodic protection. Inductive current and fault levels to be managed as per AS2885 and AS4853 and other specific standards requirements for pipelines in the vicinity of high voltage transmission lines. - NG disperses readily upwards, minimising chances of ignition. - Gas is odourised, allowing for detection and subsequent response in case of a small leak before it can develop into a larger leak. - QA during production and installation, construction DCVG.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
3. Nearby explosion at neighbouring natural gas pipeline or tie-offs.	Incident (wear and tear, mechanical impact, lightning strike etc. etc.) at the parallel natural gas pipeline.	Possible damage to gas pipeline with release of natural gas (NG). If ignition, then possibility of flash or jet fire. Injury and property damage.	- Internal risk management procedures / systems by gas pipeline operator. - Pipeline integrity plan (incl. protection, pigging etc. to monitor integrity of pipeline and coating inspection). - 24 hour monitoring of natural gas pipelines. - Dial-Before-You-Dig and signposting. - NG disperses readily upwards, minimising chances of ignition. Explosion not credible in unconfined situation. - Buried pipelines. - Thickness and grade of pipelines. - The pipelines are separated by at least 7 meters from each other. Further, the existing pipeline is buried at 750mm depth while the new pipeline will be buried at 900mm depth. It is unlikely that an explosion in one pipeline would expose the other pipeline and in which case research has shown that the adjacent pipeline cannot be damaged by the radiative heating (Ref 8).
4. Pressure excursion leads to failure of the pipeline.	Operational error upstream or downstream facility.	Overpressuring the gas pipeline causing failures, leaks and release of natural gas. If ignition, then possibility of fire. Injury and property damage.	- Pipelines constructed and hydrotested to AS2885 requirements. - The gas pipeline can operate against closed head (i.e. the main valve at the entrance to the site may be closed). - Continuous observation of pressure of pipeline from Control Centre at Young (NSW). Lack of control for several hours required before pressure could exceed critical levels. - High-pressure trip and automatic line-break protection isolating flow of natural gas. - Mechanical over pressure protection & controls at compressor stations.

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Event	Cause/Comments	Possible Consequences	Prevention/ Protection
5. Spontaneous loss of integrity of pipe	Construction defect or operational error (repeated).	Massive release of natural gas. If ignition, then possibility of flash or jet fire. Injury and property damage.	- X-raying of welds as required. - 100% UT of ERW seam weld. - Cathodic protection. - Design for pipelines to limit crack propagation to about two pipe lengths. - Pipeline complying with AS2885 and other specific standards. - Pipeline has integrity management plan. - Pipeline subject to CP monitoring, ILI and DCVG at regular intervals.
6. Erosion results in damage to piping and equipment.	Flooding	Potential for flood waters to wash away soil cover. May cause pipeline to be exposed. Possibility of damage to coating and subsequent corrosion issues. If not corrected may eventually lead to failure of pipeline.	- Control of erosion through regular and periodic patrols and inspections (aerial patrols, ground patrols after heavy rain/flooding, landowner liaison). - Repair to soil cover if erosion.
7. Land subsidence results in pipeline damage.	Mining activities in area or earthquake creates.	Failure of pipeline resulting in potential for rupture or massive leak. Release of natural gas. If ignition, then possibility of flash or jet fire. Injury and property damage.	- Site is not affected by mine subsidence. - Pipe to be designed to AS2885 requirements in terms of strength of material and design.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
8. Aircraft, train or heavy vehicle crash result in damage to pipeline resulting in hazardous releases.	Aircraft crash. Heavy vehicle crash.	Potential damage to pipeline resulting in hazardous releases, fire / explosion.	- Buried pipeline unlikely to be susceptible to aircraft, train or heavy vehicle crash. - MLVs will be located safely away from potential road or train crash locations. - MLVs will be surrounded by security fencing which will assist in containing a vehicle. - Automatic line break isolation valves minimises amount of gas released if gas pipe is damaged. Possibility of remote activation of isolation valves by Young Controller. - Aviation safety standards to apply.
9. Damage to pipeline through terrorism / vandalism.	Malicious damage.	Massive release of natural gas. If ignition, then possibility of flash or jet fire.	- Buried pipeline. - MLVs surrounded by security fence. - Any building doors will be fitted with intruder alarms.
10. Neighbouring fire.	Bush / brush fire.	Possible heat radiation at pipeline. If damage to pipe and equipment then possibility of release of hazardous material and fire risk.	- Control of vegetation in easement. - Buried pipeline is unlikely to be affected by heat radiation. - Above ground valves are fire safe.

5 POTENTIAL HAZARDOUS INCIDENTS AND THEIR CONTROL

Safety management systems allow the risk from potentially hazardous installations to be minimised by a combination of hardware and software factors. It is essential to ensure that hardware systems and software procedures used are reliable and of the highest standard in order to assure safe operation of the installations.

Safety features of particular interest to the present project are detailed below.

5.1 HARDWARE SAFEGUARDS, GENERAL

Hardware safeguards include such factors as the layout and design of the installations and equipment, and their compliance with the relevant codes, technical standards, and industry best practice.

All systems handling dangerous goods will need to comply with the following Acts, Regulations and Codes in their latest edition. Below are listed some of the most relevant:

- AS 2885 for high pressure pipeline;
- AS 4041 - 2006 Pressure Piping
- AS 1074 - Steel Tubes & Tubulars;
- AS 1836 - Welded Steel Tubes for Pressure Purposes;
- AS 1210 - Unfired Pressure Vessel Code;
- AS 2919, AS 3765.1 or AS 3765.2 - Protective clothing; and
- AS1345 - Identification of the Contents of Pipes, Conduits and Ducts.

Pipe fittings, supports, and all other ancillary items will also need to comply with appropriate Australian Standards whether referenced above or not.

5.2 HARDWARE SAFEGUARDS, SPECIFIC

Leak of Natural Gas from the Gas pipeline

Australian Standard AS2885 (Reference 5) sets the minimum standard for high-pressure pipelines in Australia. This code gives detailed requirements for the design, construction and operation of gas and liquid petroleum pipelines. It has gained wide acceptance in the Australian pipeline industry. AS2885 also sets the classification of locations which guide the designer in the assessment of potential risks to the integrity of the pipeline, the public, operating and maintenance personnel as well as property and the environment.

AS2885 accommodates changes in population density by its location classification scheme concept. The classification scheme allows broad division of the pipeline design requirements according to whether the pipeline is to be installed in rural, semi-rural, suburban or urban areas. For each of these classifications the minimum design requirements in terms of wall thickness and depth of cover are specified.

The pipeline will run in areas classified as *Class R1 - Broadly Rural* for most part of the length of the run (as per the AS2885.1 so called *primary location classes*).. Some areas are or are expected in the near future to be classified as *R2 – Rural Residential.*

The so called *secondary location class* will be defined during the AS2885.1 risk assessment (not part of the scope for this assessment).

Allowance is made in AS2885 for the improvement in safety performance possible through the use of thick walled pipe with a low design factor. AS2885 also mandates that the integrity of the pipeline be maintained throughout the pipeline operating life.

The proposed safeguards for the pipeline are detailed below. The safeguards have been grouped together under the potential hazardous events associated with the pipeline (as defined in the Hazard Identification Word Diagram in Table 8 above). These incidents have been collated by a group of six European gas transmission companies, based on pipeline incidents relevant to pipeline design and operation in Europe (Reference 9). The data was collated covers a length-time of more than 970,000 km-yrs. Experience within Australia (EAPL, AGL etc.) indicates that the learning from these incidents can be directly translated to the Australian conditions.

- External interference is historically by far the main cause of loss of gas and accounts for about 40% of all incidents leading to a release of gas.

  For the pipeline under study, this potential is minimised in the present development through the fact that AS2885 requires the pipeline to be buried to 750mm (or 450mm in rock). Note that the new pipeline will be buried at 900mm depth while the existing pipeline is buried at 750mm depth.

  Further, signage will be provided along the pipe route, including Dial Before You Dig information.

  The pipeline presents a certain resistance to penetration through use of appropriate pipe thickness (6.8 to 9.7 mm) and adequate design factor as per AS2885.

  In the very unlikely event of damage to the pipeline, which causes a major leak, a sudden pressure drop would result in alarm initiation in the Control Room in Young allowing automatic or remote activated closing of the mainline valves of either side of the leak thus minimising the amount of gas that could be released into the atmosphere.

  Note also that natural gas disperses readily upwards, reducing chances of ignition. Explosion is not credible in an unconfined situation.

Valve stations are potentially more at risk of a loss of containment due to the presence of small bore attached piping, which is required for pressure tappings. These small-bore pipes are historically known to be more vulnerable to failure.

The major mitigating features at the valve station are firstly the fact that the valve site is conspicuous and therefore reduces significantly the accidental mechanical interference for which a buried pipe is vulnerable. Secondly, the instrumentation off-take line would most likely be installed with a restriction orifice, which would severely restrict the potential outflow caused by damage to the instrumentation. Thirdly, the layout and siting of the valve stations will be subjected to a rigorous Hazard and Operability Study (HAZOP), which will result in improvements to the design to limit their hazard potential.

- *Construction defect / material failure:* This is a known cause of failure of pipelines and accounts for approximately 15% of all incidents.

  For the pipeline under study, the Australian Pipelines Code (AS2885) would be adopted as a minimum requirement for the design and construction. The pipeline would be constructed of ERW piping of 457 mm diameter (NB). The pipe seam weld will be 100% examined ultrasonically and the circumferential butt welds will be 100% radiographed.

  The pipeline will also be also subject to 1.25x hydrotest minimum.

  Further, inherent design safeguards will be provided by ensuring that the piping is manufactured from high tensile steel of known quality, and subject to quality control inspections to ensure high standard.

- *Corrosion:* Corrosion accounts for approximately 15% of all historical incidents. The result of the corrosion is mainly pinholes and cracks.

  The pipeline under study will be coated with fusion bond epoxy (FBE) and be cathodically protected. Regular pipeline patrols will be undertaken. A corrosion protection team will survey the pipeline each year to identify any areas where cathodic protection has become ineffective. Potential corrosion leaks will be detected by in-line inspection and protected against by cathodic protection systems. Gas is odourised, improving likelihood of detection and response to a pinhole leak before it develops into a larger leak. A number of corrosion detection techniques, including ILI, DCVG & CP surveys.

  Note that internal corrosion virtually absent with clean hydrocarbon.

  In the unlikely event of a corrosion leak, it can be detected through the fact that the vegetation is browning off around ground leak (lack of oxygen) and that a small hole will be sonic – possible detection through high pitched sound.

- *Hot tap by error*: Hot-tapping or hot tapping by error (i.e. hot-tapping the wrong pipeline) is possible and has occurred in the past in the world (approximately 15% of all incidents).

For the pipeline under study, this possibility is prevented through the fact that hot tapping is a highly specialised field in Australia and only very few, highly trained, groups can perform this task.

Further, the neighbouring pipeline is much smaller diameter (12 inch (or 305mm) compared with the 18 inch (or 457mm) of the new pipeline) making it even more unlikely that a specialised crew would mistake one pipeline for the other.

- *Ground movement*. Earthquakes account for about 5% of all historical incidents could potentially cause a failure of a pipeline due to the high forces involved. Earthquakes are not particularly common in this area and steel pipelines have been shown to be very resistant to failure in these circumstances.

- *Flooding:* A geotechnical study was completed for the existing pipeline. The information in this study will be used also for the new pipeline. Further, the pipeline route will be subject to routine inspections and, if required, to maintenance and repair of cover as required (e.g. if erosion is identified).

- *Land subsidence or mining activity*: Site is not affected by mine subsidence. The information from the geo technical study performed for the existing pipeline will be used also for this new pipeline.

- *Aircraft, train or truck crash:* The gas pipeline, being buried, is unlikely to be damaged in case of an aircraft, train or truck crash. There will be no above ground facilities adjacent to train crossings. Few facilities are closer to road. All will be fenced and appropriate barrier will be installed. The preventative and protective features of this site makes the risk of such crashes negligible. This scenario, while theoretically possible, does not appear credible for the present development at this stage of the development.

- *Damage to pipe through terrorism / vandalism / unlawful entry to site / sabotage:* The pipe will be buried for the most part. Further, where above ground structures (i.e. at the valve stations), the site would be fenced with access control.

- *Bush / grass fire:* A bush fire is highly unlikely to affect a buried gas pipeline. The bush fires that have burned over for example the main Moomba to Wilton natural gas pipeline have not damaged the gas pipeline or any of its above ground facilities. A bush /grass fire asset protection zone will be decided in consultation with rural fire services. Clearance zone will be provided at the off-take compound with control of vegetation. The risk of damage to the pipeline from a bush fire or grass fire to the pipeline or above ground facilities is very low if not negligible.

- *Other / unknown causes*. Rare or unknown causes form about 10% of all historical incidents. They are mainly of the pinhole crack category. The following potential incidents have been canvassed for the present development:

  - *Valve gland nut leak or flange leak or maintenance failure at valves and scraper stations*. The pipeline is designed with the minimum number of flanges and welded connections are used wherever possible. Periodic surveillance will be carried out of the pipe and valve points. All valves will be exercised periodically. All above ground valve sites are fenced and secured to exclude the public. Icing up at leak point improves detection. Further, the gas is odourised which would improve the likelihood of a small leak and subsequent response, before it develops into a larger leak.

Nearby explosion. The potential for a domino incident due to an incident at the gas mainline was canvassed. The preventative features for this type of incident include internal risk management procedures / systems in use by the APA Group managing both pipelines; the pipeline integrity plans (incl. systems in use to monitor integrity of pipeline and coating inspection); their thickness and grade; and the 24 hour monitoring of natural gas and pipeline. Further, natural gas disperses readily upwards, minimising chances of ignition and making explosion not credible in unconfined situation; and the fact that all pipelines are buried at a depth of at least 750mm (450mm in rock).

Further, the Pipeline Research Council International (PRCI) commissioned the Battelle Memorial Institute to assess available validated models to assist gas companies in determining the minimum spacing between adjacent pipelines to help ensure safe and reliable operation in the event of a rupture. The result of this work was published 2nd April 2002 and was reviewed by Mr Bill Holmes and reported in Ref 8. The research showed that for the rupture of a pipeline to cause damage to an adjacent pipeline the sequence of events expected is:

1. Loss of integrity of the initiating pipeline leads to formation of a crater.

2. The escaping gas is ignited and forms a sustained flame.

3. The flame heats the uncovered adjacent pipeline.

Further, it showed that if the crater does not expose the adjacent pipeline, then it cannot be damaged by radiative heating.

The report by Battelle discusses the development and application of a pair of models that may be used to assess appropriate pipeline spacing. The first can be termed the “crater” model and the second the “radiative” model.

The “crater” model estimates the size of the crater produced by the initial rupture. In the report the crater width versus depth of cover were estimated. For the 900mm cover proposed for the Young Wagga Loop the crater diameter is estimated to be about 7m maybe as big as 9m (4.5m radius). From observations of such craters they are reasonably symmetric about the pipeline. Therefore, there should be at least 2m of soil remaining to protect the adjacent pipeline from radiative heating. In such a case there is no need for the second “radiative” model and the adjacent pipeline is considered safe from such an event.

- Operational error causes pressure excursion leading to failure of the pipeline. The pipeline is to be hydrotested at a minimum of 1.38 times the MAOP (maximum allowable operating pressure) and can operate against closed head.

The potential for a gas release is extremely small. The proposed development does not increase in any significant way the risk of a bush fire in the forested areas through which the pipeline travels. As a consequence, local fire brigades will not have any significant demand on their resources.

5.3 SOFTWARE SAFEGUARDS

The APA Group has a commitment to Occupational Health and Safety (OH&S) and has numerous policies and procedures to achieve a safe workplace. Written safety procedures are established and reviewed periodically.

The pipeline will need to comply with all codes and statutory requirements. In addition, special precautions are observed as required by the site conditions, in particular, standards and requirement on the handling of pressurised, flammable gases. All personnel required to work on gas pipelines are trained in their safe use and handling, and are provided with the relevant safety equipment.

The APA Group would have the responsibility of managing the gas pipeline and ensuring that experienced personnel are appropriately trained.

A defined Maintenance Management system, setting out requirements for tests, inspections and repairs.

A Permit to Work system (including Hot Work Permit) and Control of Modification systems is in use to control work on pipelines and to control pipeline and structure from substandard and potentially hazardous modifications.

Injury and incident management is proceduralised and people are trained in how to report incidents. There is an established incident reporting and response, providing 24 hour coverage.

Protective Systems would be tested to ensure they are in a good state of repair and function reliably when required to do so. This would include scheduled testing of trips, alarms, gas detectors, relief devices and fire protection systems.

6 CONSEQUENCE ANALYSIS

6.1 EVALUATION TECHNIQUES

As natural gas is non toxic, the evaluation of consequences requires only the determination of fire radiation and explosion overpressure. For both fires and explosions, it is necessary to determine the leak rate and duration for each incident. Radiation effects are then determined using the point source method while overpressure effects are determined using the TNT equivalent model in Reference 10.

The explanation of the nomenclature used in the equations below is listed in Table 11 at the end of this Chapter.

6.1.1 Leak Rates

For gas or vapour flows (as for natural gas), the appropriate equation is:

$$\dot{m} = 0.8AP\sqrt{\frac{M\gamma}{zRT}(\sqrt{\frac{2}{\lambda+1}}^{\frac{\gamma+1}{\gamma-1}}}$$

Note that this applies to the condition known as critical or choked flow, which applies when the internal pressure is more than double the atmospheric pressure (approximately).

6.1.2 Duration

The duration of a leak would depend on the hardware systems available to isolate the source of the leak, the nature of the leak itself and the training, procedures and management of the facility. While in some cases it may be argued that a leak would be isolated within one minute, the same leak under different circumstances may take longer to isolate.

The approach used in this study for failure scenarios identified is to assume that once the leak or rupture is established it will be continuous. This is a conservative assumption, particularly for major and rupture leaks which would quickly depressure and burn with less intensity.

The mass of flammable gas contained in a cloud which could flash or explode is set at the total amount which would leak out in 3 minutes. This is based on the assumption that a cloud travelling in the direction of the wind would either encounter a source of ignition within this time[3] or would disperse to concentrations below the Lower Flammable Limit (LFL).

6.1.3 Radiation Effects - The Point Source Method

Radiation effects are evaluated using the point source method, which assumes that a fire is a point source of heat, located at the centre of the flame, and radiating a proportion of the heat of combustion. The radiation intensity at any distance is then determined according to the inverse square law, making allowance for the attenuating effect of atmospheric water vapour over significant distances (e.g. 100m or more).

$$I = \frac{Qf\tau}{4\Pi r^2}$$

The rate of heat release, Q, is given by:

$$Q = \dot{m}H_C$$

6.1.4 Explosion Effects - The TNT Model

For explosions, the amount of gas or vapour resulting from the leak is important. For gases this is the total quantity leaking out for the duration of interest.

The equivalent mass of TNT is then determined using the following relationship:

$$m_{TNT} = \frac{\alpha H_C m_V}{4600}$$

The overpressure effect from the vapour cloud is determined using a correlation developed for TNT, which relates the scaled distance (a function of actual distance and mass of TNT) to the overpressure. The scaled distance is given by the relationship in equation:

$$\lambda = \frac{r}{(m_{TNT})^{1/3}}$$

6.2 IMPACT ASSESSMENT

The above techniques allow the level of radiation or overpressure resulting from fires and explosions to be determined at any distance from the source. The effect or impact of heat radiation on people is shown in Table 9 while Table 10 shows the effects of explosion overpressure.

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[3] In a relatively moderate wind force of say 4 m/s, the cloud would after 3 minutes have covered a distance of 240 metres.

Table 9 - Effects of Heat Radiation

Radiant Heat Level (kW/m^2)	Physical Effect (effect depends on exposure duration)
1.2	Received from the sun at noon in summer
2.1	Minimum to cause pain after 1 minute
4.7	Will cause pain in 15-20 seconds and injury after 30 seconds' exposure
12.6	Significant chance of fatality for extended exposure High chance of injury
23	Likely fatality for extended exposure and chance of fatality for instantaneous (short) exposure
35	Significant chance of fatality for people exposed instantaneously

Table 10 – Effect of Explosion Overpressure

Overpressure (kPa)	Physical Effect
3.5	90% glass breakage. No fatality, very low probability of injury
7	Damage to internal partitions & joinery 10% probability of injury, no fatality
14	Houses uninhabitable and badly cracked
21	Reinforced structures distort, storage tanks fail 20% chance of fatality to person in building
35	Houses uninhabitable, rail wagons & Facility items overturned. Threshold of eardrum damage, 50% chance of fatality for a person in a building, 15% in the open
70	Complete demolition of houses Threshold of lung damage, 100% chance of fatality for a person in a building or in the open

Table 11 – Nomenclature for Section 6

Label	Explanation
A	Area of hole, m^2
C_p	Average liquid heat capacity, kJ/kg.K
f	Fraction of heat radiated
H_c	Heat of combustion, kJ/kg
H_v	Heat of vaporisation, kJ/kg
I	Radiant heat intensity kW/m^2
M	Molecular weight
m	Mass, kg
m_v	Mass of vapour (in cloud), kg
m_{TNT}	Equivalent mass of TNT, kg
$\dot{m}$	Mass flow rate of leak, kg/s
P	Pressure, Pa
P_1	Upstream absolute pressure, Pa
Q	Heat release rate, kW
R	Universal gas constant, 8.314 J.K/mol
r	Distance from fire/explosion, m
T	Temperature, K
T_1	Storage temperature, K
T_b	Boiling point, K
t	Duration of leak/time, seconds
z	Gas compressibility factor
α	Explosion efficiency factor
γ	Ratio of specific heats (~1.4)
λ	Scaled distance
ρ	Density, kg/m^3
τ	Atmospheric transmissivity

6.3 Consequence Calculations – Natural Gas Incident

This initial outflow rates estimated for natural gas releases are shown in Table 12. The results predict that the rate of decrease in outflow rate for a full bore rupture is dramatic with a drop to less than half of the initial flow within seconds and further rapid decay. However, the present PHA has assumed that the initial release rate remains until isolation can be achieved.

Table 12 – Release Rates

Small leak (5mm)	Intermediate leak (25 mm)	Massive leak (100 mm)	Full bore (guillotine)
0.29 kg/s	7.2	115 kg/s	2.4 tonnes/s (first few seconds)

The distance from the source of the fire to the specified heat radiation for jet fire scenarios is listed in Table 13 below.

Table 13 – Heat Radiation Distances from Jet Fires

Hole size	**Distance to Heat radiation (metres)**		
	4.7kW/m^2	**12.5kW/m^2**	**23.5kW/m^2**
Small leak (5mm)	6	4	3
Intermediate leak (25 mm)	30	18	14
Massive leak (100 mm)	120	74	55
Full bore (guillotine)[4]	525	310	240

The distance from the source to the envelope of the flash fire is presented in Table 14 below. According to established correlations between overpressure effects and heat radiation, the pressure wave of 70kPa (scaled distance of 4) is taken as defining the foot print of an equivalent size flash fire. Fatality for a person within this foot print is assumed as 100% while fatality for a person outside the foot print is assumed as 0%. The assumptions for flash fires are according to those in the *Hazard Analysis* course notes (Ref 11).

Table 14 – Flash Fire Consequence Distances

Hole size	**Distance to Heat radiation (metres)**		
	4.7kW/m^2	**23.5kW/m^2**	**100% fatality**
Small leak (5mm)	25	15	12
Intermediate leak (25 mm)	40	35	30
Massive leak (100 mm)	150	80	70
Full bore (guillotine)[5]	350	315	250

[4] The event resulting from a full bore rupture is more likely to result in a short flash fire of great intensity followed by a longer duration jet fire of les intensity as the pipeline depressurises through the rupture.

The distance from the source of the release to the specified overpressure for explosion scenarios is listed in Table 15 below.

Table 15 – Overpressure Distances from Explosions

Hole size	Distance to Explosion Overpressure (metres)		
	7 kPa	14 kPa	70 kPa
Small leak (5mm)	30	25	15
Intermediate leak (25 mm)	120	75	40
Massive leak (100 mm)	300	200	75
Full bore (guillotine)	450	380	220

The calculations sheets are included in Appendix 1.

[5] The event resulting from a full bore rupture is more likely to result in a short flash fire of great intensity followed by a longer duration jet fire of les intensity as the pipeline depressurises through the rupture.

7 FREQUENCY ANALYSIS

7.1 GENERIC EQUIPMENT FAILURES

A summary of all incident scenarios that are incorporated into the PHA are listed in Appendix 1. The frequency of each postulated equipment failure was determined using the data in the table below.

The frequencies used for all below ground gas piping and for all pipelines installed as per AS2885 (Reference 5) requirements are based on incident statistics between 1988 and 1992, gathered by the European Gas Pipeline Incident Data Group (EIGPIDG), Reference 12.

This data source has been chosen based on the extensive statistical significance of the data available (1,470,000 kilometre-years)[6] and because of the similarities between the Australian Standard requirements and the requirements used in the European countries included in the incident statistics (Britain, Belgium, France, Netherlands, and Germany). These statistics provide details of leak rates for small and large holes but do not provide information on rupture frequencies.

Rupture frequency data is therefore taken from the British Gas failure data as sourced by the British Gas Corporation Engineering Research Station (Reference 13) over 250,000 km-yrs.

Two different wall thicknesses will be used depending on the location of the pipeline. In general, the pipeline will be constructed in 6.8mm thick pipe. Where the pipeline goes under roads or railways or where it passes major centres it will be constructed in thicker pipe (9.7mm wall thickness).

The failure frequencies for 6.5mm and 9.7mm thick pipelines as per references 12 and 13 are listed below.

Table 16 - Equipment Failures and Associated Frequencies

Type of Failure	Failure Rate (pmpy)
GAS PIPELINES (>100mm NB; 6.8 mm pipe thickness)	
<20 mm hole – steel pipeline	0.055/ m
<80 mm hole – steel pipeline	0.138 / m

[6] As a comparison, the available statistics in Australia are based on (only) 160,000 km-yrs. The available statistics from the US Dept of Transportation Office of Pipeline Safety is based on 970,000 km-yrs but the standards used in the US are understood to be further from the Australian standards than those in use in Europe (as included in the EGPIDG).

Type of Failure	Failure Rate (pmpy)
Guillotine fracture (full bore) – steel pipeline	0.0015 / m
GAS PIPELINES (>100mm NB; 9.7 mm pipe thickness)	
<20 mm hole – steel pipeline	0.027/ m
<80 mm hole – steel pipeline	0.076 / m
Guillotine fracture (full bore) – steel pipeline	0.0007 / m

7.2 PROBABILITY OF FLAMMABLE OUTCOME

The probability of ignition if leak were based on the Cox, Lees and Ang data (Reference14), as follows:

Table 17 – Ignition Probability

Leak size (mm)	Probability of ignition
<20mm	0.027
20 to 100 mm	0.019
>100 mm	0.235

The probability of a delayed ignition is taken as $M^{0.333}$, with M being the mass (in tonnes) of flammable vapour in the cloud (Reference 15). This equation was used to determine the probability of a flash fire or an explosion.

The probability of the delayed ignition resulting in an explosion was taken as 0.1 and as a flash fire as 0.1.

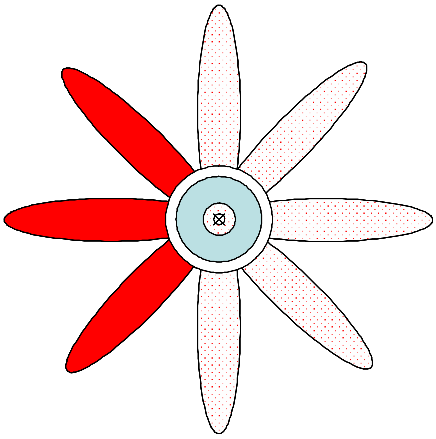
The probability of a jet fire was taken as:

$$P_{\text{jet fire}} = P_{\text{ignition}} - P_{\text{explosion}} - P_{\text{flash fire}}$$

The frequency of outcome of each individual incident scenario is listed in the spreadsheet in Appendix 1.

Jet fires are directional (as opposed to flash fires that are omni directional). While a jet fire can be directed towards any point in the sphere, about one third of all jet fires are assumed to be directed towards a boundary. This is based on the concept depicted in Figure 2 below, with the dark jets being those assumed to be directed towards the boundary and the light being assumed to be directed away from the boundary.

Figure 2 – Jet Fire Distribution



7.3 RELATIONSHIP BETWEEN EXPOSURE AND EFFECT

The relationship between exposure and effect was estimated based on the probit equation for heat radiation from jet fires. In the case of flash fires, 100% fatality was assumed for anyone engulfed within the flaming cloud, and 0% probability outside it.

8 RISK RESULTS AND COMPARISON WITH RISK CRITERIA

8.1 OVERALL INDIVIDUAL RISK OF FATALITY

Figure 3 and Figure 4 show the risk-transect for individual fatality from the 6.8MM and the 9.7MM (wall) thick natural gas pipeline respectively. The risk criterion which is relevant for residential development (1 pmpy) is never reached for either pipeline. The pipeline does not travel next to any sensitive development (such as schools, hospitals etc.) where lower risk criteria would be relevant.

Figure 3 – Individual Fatality Risk Transects for the 6.8MM Gas Pipeline

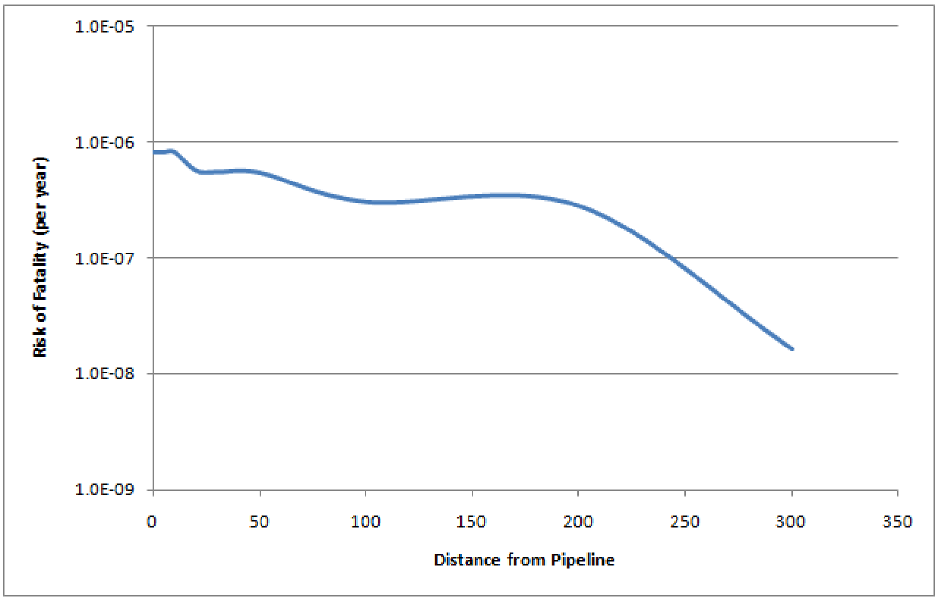
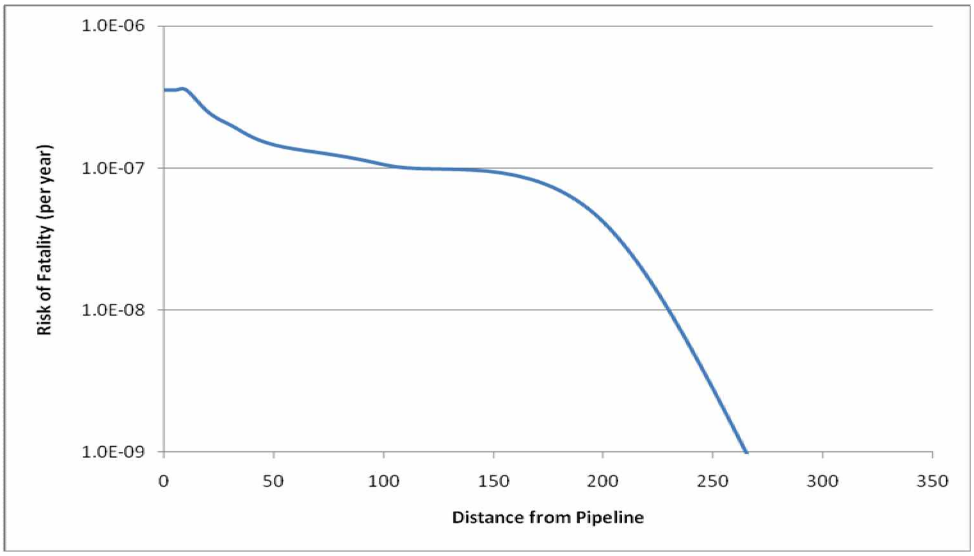


Figure 4 – Individual Fatality Risk Transects for the 9.7MM Gas Pipeline



8.2 INJURY RISK

Figure 5 and Figure 6 show the injury risk-transect for the 6.8MM and the 9.7MM (wall) thick natural gas pipeline respectively. The risk criterion which is relevant for residential development (50 pmpy) is never reached for the pipeline.

Figure 5 – Injury Risk Transects for the 6.8MM Gas Pipeline

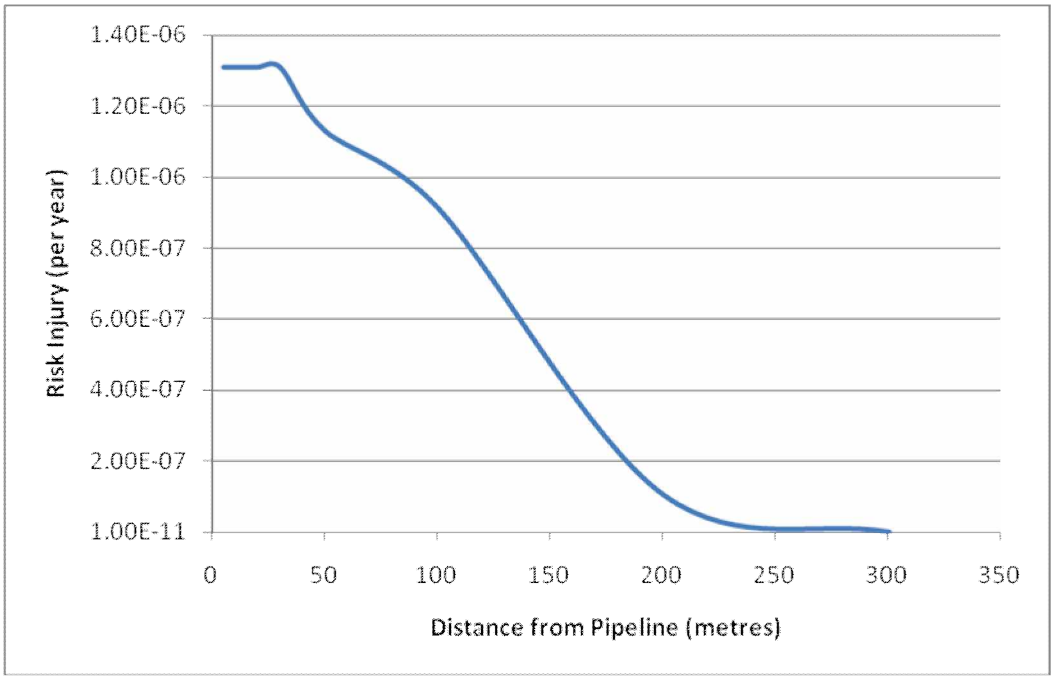
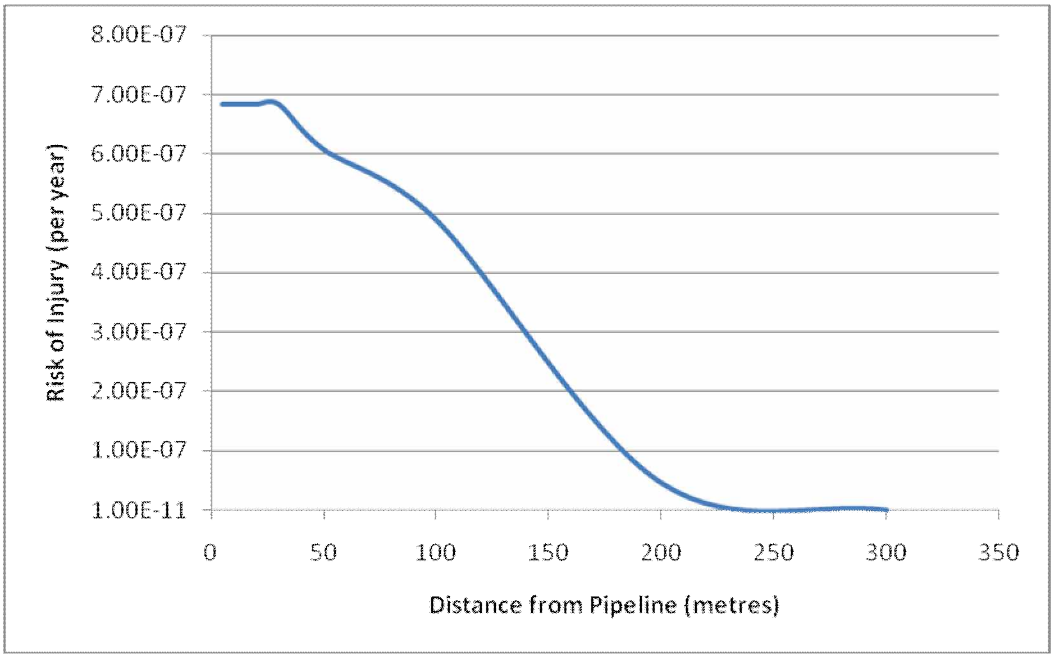


Figure 6 – Injury Risk Transects for the 9.7MM Gas Pipeline



8.3 PROPAGATION RISK

Figure 7 and Figure 6 show the injury risk-transect for the 6.8MM and the 9.7MM (wall) thick natural gas pipeline respectively. The risk criteria relevant for residential development (50 pmpy) is never reached for the pipeline.

Figure 7 – Propagation Risk Transects for the 6.8MM Gas Pipeline

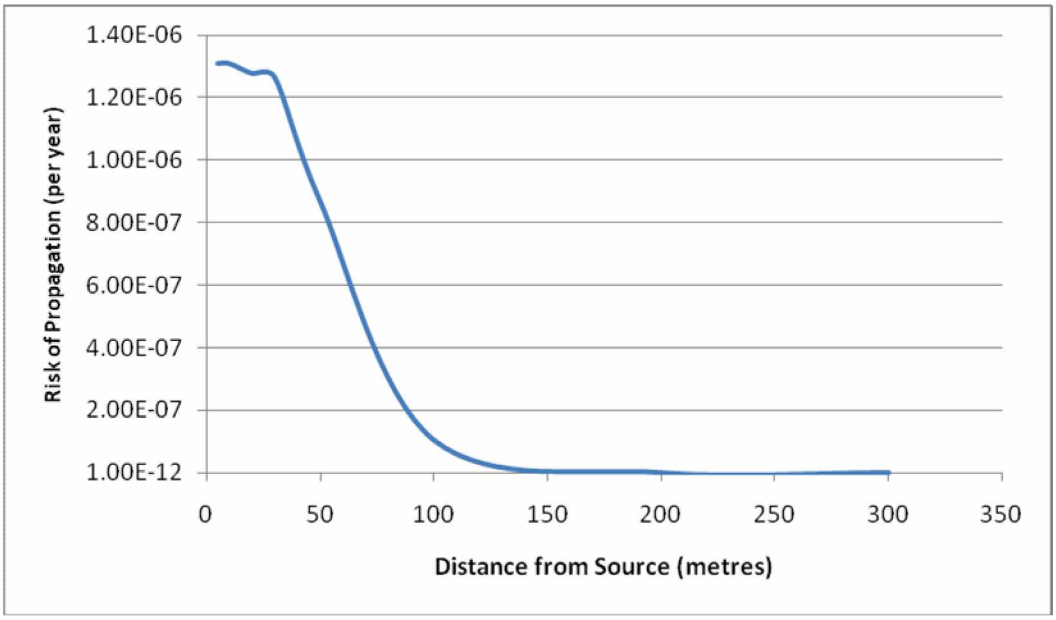
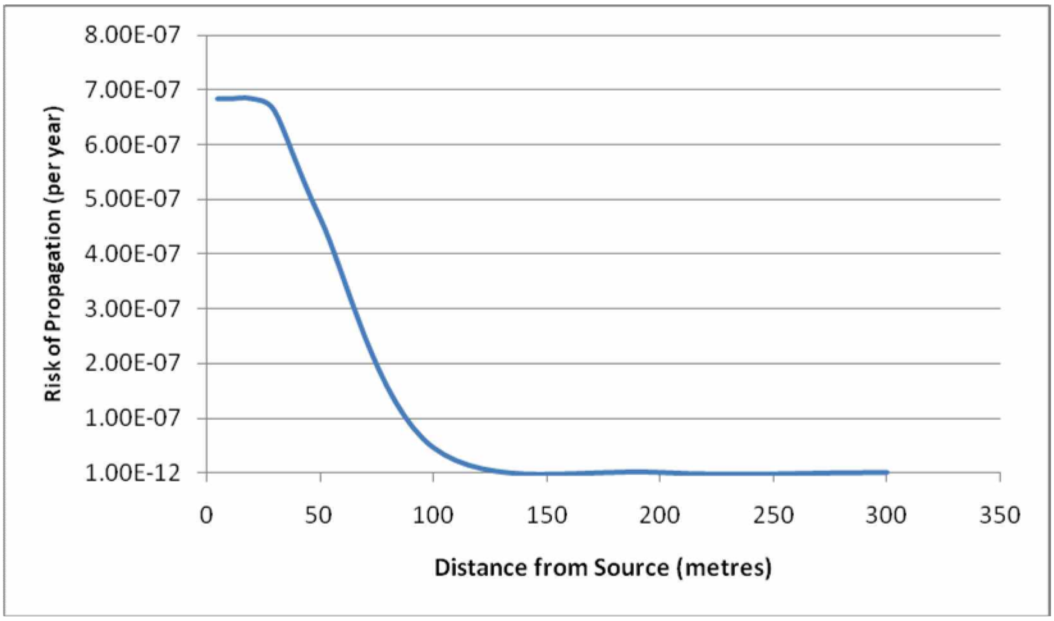


Figure 8 – Propagation Risk Transects for the 9.7MM Gas Pipeline



8.4 ADHERENCE TO RISK CRITERIA

The quantitative analysis showed that:

Individual Risk of Fatality: The risk of fatality associated with the gas pipeline is well below the criterion for new installations of one chance in a million per year (1×10^{-6}/yr). The 1×10^{-6}/yr individual fatality risk for the pipeline is contained well within the pipeline easement.

It follows that the risk of fatality at the nearest open space and the nearest industrial area are also well below the criterion of ten and fifty chances per million years respectively (10×10^{-6}/yr and 50×10^{-6}/yr) and contained within the pipeline easement.

Injury Risk: The risk of injury at the nearest residential area is well below the criterion for new installations of fifty chances per million years (50×10^{-6}/yr).

Propagation Risk: The risk of propagation of an incident at the gas pipeline does not encroach into any other industrial areas and is well below the criterion of fifty chances per million years (50×10^{-6}/yr).

Societal Risk: The risk of fatality does not extend anywhere close to any residential and is well within the criteria for business / industrial areas. It is therefore considered that the proposed pipeline does not have a significant impact on societal risk.

9 CONCLUSIONS

9.1 OVERVIEW OF RISK

The main hazard associated with the proposed gas pipeline is associated with the handling of natural gas (predominantly composed of methane gas), which is a flammable gas held under pressure.

The predominant mode in which a hazardous incident may be generated is associated with a rupture or leak.

A leak would generally only have the potential to cause injury or damage if there was ignition, which resulted in a fire or explosion incident. The factors involved are:

- Failure must occur causing a release. There are several possible causes of failure, with the main ones being corrosion and damage to the equipment by external agencies.

- The released material must come into contact with a source of ignition. In some cases this may be heat or sparks generated by mechanical damage while in others, the possible ignition source could include non-flame proof equipment, vehicles, or flames some distance from the release.

- Depending on the release conditions, including the mass of material involved and how rapidly it is ignited, the results may be a localised fire (for example a so called jet fire) or a flash fire. As the pipeline runs through open areas, an explosion of the vapour cloud formed through the release is considered highly unlikely.

- Finally, for there to be a risk, people must be present within the harmful range (consequence distance) of the fire or explosion. How close the people are will determine whether any injuries or fatalities result.

9.2 SUMMARY OF RISK RESULTS

Even though many of the assumptions in this PHA are conservative, the results show that the risk associated with the gas pipeline is very low. The most stringent risk criteria, as required by the NSW Department of Planning, are adhered to.

Appendix 1

Risk Calculation Sheets 6.8MM Pipeline

Preliminary Hazard Analysis of the Natural Gas Delivery Pipeline between Young and Bomen in NSW

Appendix 1 – Risk Calculation Sheets (6.8MM Pipeline)

The calculations sheets for the 6.8mm thick pipeline are provided below for reference. The calculations sheets for the 9.7mm pipeline can be provided if required.

OUTFLOW RATES

Gas flow rate = 0.8 x A x P {M/zRT x [(2/gamma + 1)$^{0.5}$]$^{(gamma+1)/(gamma-1)}$}$^{0.5}$

R =	8.314	J.K/mol	
T =	293	K	
gamma =	1.31	ratio of specific heat	
z =	1	assume ideal gas	
M =	18	g/mol	
P =	8.50E+06	Pa	Pipeline Op. Pressure

LATERAL GAS SUPPLY PIPELINE RISK ASSESSMENT

Leak size (m)	Cross section	Flow rate (kg/s)	
5.00E-03	1.96E-05	2.88E-01	Pipeline Op. Pressure
2.50E-02	4.91E-04	7.21E+00	Pipeline Op. Pressure
1.00E-01	7.85E-03	1.15E+02	Pipeline Op. Pressure
4.57E-01	1.64E-01	2.41E+03	Pipeline Op. Pressure

FREQUENCY ASSESSMENT

EGPIDG Data for 457mm pipelines (Failure rate per million kilometers per year)						
Pipe thickness (mm)	**5.9**	**6.8**	**7.1**	**8.1**	**8.5**	9.7
Ext interference						
pinhole	62	38	35	20	17	10
hole	148	130	120	100	95	68
Corrosion						
pinhole	0	0	0	0	0	0
hole	0	0	0	0	0	0
Construction/Material defect						
pinhole	9	9	9	9	9	9
hole	0	0	0	0	0	0
Ground movement						
pinhole	3	8	8	8	8	8
hole	8	8	8	8	8	8
Hot tap by error						
pinhole	0	0	0	0	0	0
hole	0	0	0	0	0	0
TOTAL PINHOLE	**74**	**55**	**52**	**37**	**34**	27
TOTAL HOLE	**156**	**138**	**128**	**108**	**103**	76

BRITISH GAS DATA FOR RUPTURE FREQUENCY - RURAL APPLICATION (Failure rate per million kilometers per year)						
Pipe thickness (mm)	**5.9**	**6.8**	**7.1**	**8.1**	**8.5**	9.7
Rurpture	2.2	**1.6**	1.4	1	0.9	0.7

Steel Pipe

Leak size (m)	**Frequency of failure (per km per year) for a pipe thickness of 6.5 mm**	**Probability of failure of automatic emergency isolation valve [-]**	**Probability of ignition (Cox, Lees and Ang)**	**Freq. of flammable outcome (per km per year)**
<20mm	5.50E-05	1.00E+00	0.01	5.50E-07
20 to 100 mm	1.38E-04	1.00E+00	0.07	9.66E-06
>100 mm	1.60E-06	1.00E+00	0.3	4.80E-07

Mass of gas between two MLVs						
diam pipe:	4.57E-01	m	assumes perfect gas		mass = n (mole) x M (g/mole)	
Cross section pipe	6.56E-01	m2	pV=nRT		M(methane) g/mole	16
Dist between MLVs (ap	2.60E+04	m	n=PV/RT			
Volume gas between M	1.71E+04	m3	n =	5.95E+04		
Mass gas between MLVs		kg	mass =	9.52E+05	kg	952
				952	tonnes	

Mass in Flammable cloud (tonnes) - ALB fail to operate (kg)	**Mass in Flammable cloud (tonnes) - ALB operate correctly and max mass in cloud is mass of gas between two MLVs (kg)**	**Probability of flash or explosion if ignited [-] (Ref HAZAN Course, $P=M^{0.333}$. Taken as "flash and explosion" due to the volatile nature of natural gas)**	**Probability of flash fire if ignited [-] (Assume 90% flash if "flash or explosion")**	**Probability of explosion if ignited [-] (Assume 10% explosion if "flash and explosion")**	*Hazard Analysis Course Notes*, Risk Management Group, SHE Pacific, 1999	Tweeddale, *Managing Risks and Reliability in Process Plants*
1.30E+00	1.30E+00	0.11	0.10	0.01		
2.08E+01	2.08E+01	0.27	0.25	0.03		
4.33E+02	4.33E+02	0.76	0.68	0.08		

	Freq. of flash fire (per km per year)	**Freq. of exposion (per km per year)**	**Freq. of jet fire (per km/yr)**	**Freq. of flash fire (per year, for the entire pipeline length)**	**Freq. of explosion (per year, for the entire pipeline length)**	**Freq. of jet fire (per year, for the entire length of the pipeline)**
	5.40E-08	6.00E-09	4.90E-07	7.02E-06	7.80E-07	4.90E-06
	2.39E-06	2.65E-07	7.01E-06	3.11E-04	3.45E-05	7.01E-05
	3.63E-07	3.63E-08	8.04E-08	4.72E-05	4.72E-06	8.04E-07
				3.65E-04	**4.00E-05**	**7.58E-05**

JET FIRE - POINT SOURCE METHOD

Assume :

Heat of combustion Hc=	50000	kJ/kg	***Probit $Y = -A + B \times \ln(Q \times t^n)$***		
Radiation efficiency =	0.15		A	-14.9	
Transmissivity =	1		B	2.56	
Duration of exposure =	60	s	n	1.333	
Duration for total mass of vapour in cloud	180	s			
Mass burn rate = outflow rate					

Length of jet
F. P. Lees
$L = 6M^{0.5}$ for 0<M<50 kg/s
(M = mass flow rate, kg/s)
for M>50 kg/s

Jet Fire

Leak size(mm)	Location	Burn rate (kg/s)	Heat rad (kW)	Length of jet flame metres	Distance to Heat Radiation (m) 4.7kW/m^2	12.5kW/m	23.5kW/m^2	Probit value $Y = -14.9 + 2.56 \ln(I^{1.333} t)$ 4.7kW/m^2	12.5kW/m^2	23.5kW/m^2	Probability of fatality 4.7kW/m^2	12.5kW/m^2	23.5kW/m^2
5.00E-03	Pipeline Op. Pressure	2.88E-01	2.16E+03	3.22	6.1	3.7	2.7	0.9	4.2	6.3	0	0.28	0.95
2.50E-02	Pipeline Op. Pressure	7.21E+00	5.40E+04	16.11	30.3	18.6	13.7	0.9	4.2	6.3	0	0.28	0.95
1.00E-01	Pipeline Op. Pressure	1.15E+02	8.65E+05	64.42	121.0	74.2	54.7	0.9	4.2	6.3	0	0.28	0.95
4.57E-01	Pipeline Op. Pressure	2.41E+03	1.81E+07	700.12	553.1	339.1	250.0	0.9	4.2	6.3	0	0.28	0.95

Leak size(mm)	Location	Burn rate (kg/s)	Heat rad (kW)	Length of jet flame metres	Heat radiation (kW/m2) at Distance from Centre of Flame (in metres). 1	2	5	10	20	30	50	100	200	300
5.00E-03	Pipeline Op. Pressure	2.88E-01	2.16E+03	3.22	172	43	7	2	0	0	0	0	0	0
2.50E-02	Pipeline Op. Pressure	7.21E+00	5.40E+04	16.11	4303	1076	172	43	11	5	2	0	0	0
1.00E-01	Pipeline Op. Pressure	1.15E+02	8.65E+05	64.42	68841	17210	2754	688	172	76	28	7	2	1
4.57E-01	Pipeline Op. Pressure	2.41E+03	1.81E+07	700.12	1437736	359434	57509	14377	3594	1597	575	144	36	16

Leak size(mm)	Location	Burn rate (kg/s)	Heat rad (kW)	Length of jet flame metres	Distance to this heat radiation from the source (in metres) (takes into account the length of the flame) 1	2	5	10	20	30	50	100	200	300
5.00E-03	Pipeline Op. Pressure	2.88E-01	2.16E+03	3.22	3	4	7	12	22	32	52	102	202	302
2.50E-02	Pipeline Op. Pressure	7.21E+00	5.40E+04	16.11	9	10	13	18	28	38	58	108	208	308
1.00E-01	Pipeline Op. Pressure	1.15E+02	8.65E+05	64.42	33	34	37	42	52	62	82	132	232	332
4.57E-01	Pipeline Op. Pressure	2.41E+03	1.81E+07	700.12	351	352	355	360	370	380	400	450	550	650

Leak size(mm)	Location	Burn rate (kg/s)	Heat rad (kW)	Length of jet flame metres	Probit 1	2	5	10	20	30	50	100	200	300
5.00E-03	Pipeline Op. Pressure	2.88E-01	2.16E+03	3.22	13	8	2	-3	-7	-10	-14	-18	-23	-26
2.50E-02	Pipeline Op. Pressure	7.21E+00	5.40E+04	16.11	24	19	13	8	4	1	-3	-7	-12	-15
1.00E-01	Pipeline Op. Pressure	1.15E+02	8.65E+05	64.42	34	29	23	18	13	10	7	2	-3	-5
4.57E-01	Pipeline Op. Pressure	2.41E+03	1.81E+07	700.12	44	39	33	28	23	21	17	12	8	5

Leak size(mm)	Location	Burn rate (kg/s)	Heat rad (kW)	Length of jet flame	Probability of fatality									
5.00E-03	Pipeline Op. Pressure	2.88E-01	2.16E+03	3.22	1.00	1.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50E-02	Pipeline Op. Pressure	7.21E+00	5.40E+04	16.11	1.00	1.00	1.00	1.00	0.12	0.00	0.00	0.00	0.00	0.00
1.00E-01	Pipeline Op. Pressure	1.15E+02	8.65E+05	64.42	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.00	0.00	0.00
4.57E-01	Pipeline Op. Pressure	2.41E+03	1.81E+07	700.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50

Leak size(mm)	Location	Burn rate (kg/s)	Heat rad (kW)	Length of jet flame	Probability of reaching 4.7kW/m2									
5.00E-03	Pipeline Op. Pressure	2.88E-01	2.16E+03	3.22	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50E-02	Pipeline Op. Pressure	7.21E+00	5.40E+04	16.11	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00
1.00E-01	Pipeline Op. Pressure	1.15E+02	8.65E+05	64.42	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
4.57E-01	Pipeline Op. Pressure	2.41E+03	1.81E+07	700.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Leak size(mm)	Location	Burn rate (kg/s)	Heat rad (kW)	Length of jet flame	Probability of reaching 23kW/m2									
5.00E-03	Pipeline Op. Pressure	2.88E-01	2.16E+03	3.22	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50E-02	Pipeline Op. Pressure	7.21E+00	5.40E+04	16.11	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00
1.00E-01	Pipeline Op. Pressure	1.15E+02	8.65E+05	64.42	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00
4.57E-01	Pipeline Op. Pressure	2.41E+03	1.81E+07	700.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00

PLANAGER
Risk Management Consulting

VCE - TNT METHOD

Equivalent mass TNT = [Explosion efficiency compared with TNT] x [Mass of vapour in cloud] x [Heat of combustion of vapour] / 4,600 =

Scaled distance = Radius [metres] / (MTNT)0.333

Explosion efficiency =	4%	
Hc =	50000	kJ/kg
Mass in cloud after (s) =	180	

Leak size(mm) (m)	Location	Burn rate (kg/s)	Mass in cloud (k (kg)	M(TNT) (kg)	Scaled distance 5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m	400 m
5.00E-03	Pipeline Op. Pressure	2.88E-01	5.19E+01	2.26E+01	1.8	3.5	7.1	10.6	17.7	35.4	70.9	106.3	141.7
2.50E-02	Pipeline Op. Pressure	7.21E+00	1.30E+03	5.64E+02	0.6	1.2	2.4	3.6	6.1	12.1	24.3	36.4	48.5
1.00E-01	Pipeline Op. Pressure	1.15E+02	2.08E+04	9.02E+03	0.2	0.5	1.0	1.4	2.4	4.8	9.6	14.5	19.3
4.57E-01	Pipeline Op. Pressure	2.41E+03	4.33E+05	1.88E+05	0.1	0.2	0.4	0.5	0.9	1.8	3.5	5.3	7.0

Leak size(mm) (m)	Location	Burn rate (kg/s)	Mass in cloud (k (kg)	M(TNT) (kg)	Overpresure (kPa) 5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m	400 m
5.00E-03	Pipeline Op. Pressure	2.88E-01	5.19E+01	2.26E+01	100	80.0	22.0	7.0	6.0	2.0	0.0	0.0	0
2.50E-02	Pipeline Op. Pressure	7.21E+00	1.30E+03	5.64E+02	100	100	95	80	30	9	3	2	0
1.00E-01	Pipeline Op. Pressure	1.15E+02	2.08E+04	9.02E+03	100	100	100	100	95	45	15	7	4
4.57E-01	Pipeline Op. Pressure	2.41E+03	4.33E+05	1.88E+05	100	100	100	100	100	100	80	40	11

Leak size(mm) (m)	Location	Burn rate (kg/s)	Mass in cloud (k (kg)	M(TNT) (kg)	Probability of fatality 5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m	400 m
5.00E-03	Pipeline Op. Pressure	2.88E-01	5.19E+01	2.26E+01	1.00	1.00	0.20	0.03	0.02	0.00	0.00	0.00	0.00
2.50E-02	Pipeline Op. Pressure	7.21E+00	1.30E+03	5.64E+02	1.00	1.00	1.00	1.00	0.35	0.05	0.01	0.00	0.00
1.00E-01	Pipeline Op. Pressure	1.15E+02	2.08E+04	9.02E+03	1.00	1.00	1.00	1.00	1.00	1.00	0.09	0.03	0.02
4.57E-01	Pipeline Op. Pressure	2.41E+03	4.33E+05	1.88E+05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.62	0.05

FLASH FIRE

Distance to fatality for flash fires= dist. To 70kPa = scaled distance of 4

Leak size(mm) (m)	Location	Burn rate (kg/s)	Mass in cloud (k (kg)	Flash fire danger zone (m)	Probability of Fatality 5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m	400 m
5.00E-03	Pipeline Op. Pressure	2.88E-01	5.19E+01	10	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2.50E-02	Pipeline Op. Pressure	7.21E+00	1.30E+03	30	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0
1.00E-01	Pipeline Op. Pressure	1.15E+02	2.08E+04	80	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0
4.57E-01	Pipeline Op. Pressure	2.41E+03	4.33E+05	180	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0

Leak size(mm) (m)	Location	Burn rate (kg/s)	Mass in cloud (k (kg)	Flash fire danger zone (m)	Probability of 4.7kW/m2 5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m	400 m
5.00E-03	Pipeline Op. Pressure	2.88E-01	5.19E+01	10	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0
2.50E-02	Pipeline Op. Pressure	7.21E+00	1.30E+03	30	1.00	1.00	1.00	1.00	0.00	1.00	0.00	0.00	0
1.00E-01	Pipeline Op. Pressure	1.15E+02	2.08E+04	80	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0
4.57E-01	Pipeline Op. Pressure	2.41E+03	4.33E+05	180	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0

Leak size(mm) (m)	Location	Burn rate (kg/s)	Mass in cloud (k (kg)	Flash fire danger zone (m)	Probability of 23kW/m2 5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m	400 m
5.00E-03	Pipeline Op. Pressure	2.88E-01	5.19E+01	10	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2.50E-02	Pipeline Op. Pressure	7.21E+00	1.30E+03	30	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0
1.00E-01	Pipeline Op. Pressure	1.15E+02	2.08E+04	80	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0
4.57E-01	Pipeline Op. Pressure	2.41E+03	4.33E+05	180	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0

RISK ASSESSMENT 6.8MM WALL PIPELINE

	Frequency (per metre per year)		
	Flash fire	Explosion	Jet fire
<20mm	1.46E-10	1.62E-11	1.32E-09
20 to 100 mm	6.49E-10	7.21E-11	1.90E-09
>100 mm	2.85E-10	2.85E-11	6.30E-11

Risk of fatality from jet fires (per m per yr)

Note: The calculation uses the distance from the source of the release (i.e. not the centre of the flame)

	5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m
<20mm	1.32E-09	1.32E-09	1.32E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20 to 100 mm	1.90E-09	1.90E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
>100 mm	6.30E-11	6.30E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Risk of fatality from jet fires (per m per yr)

Note: The calculation takes into account that jet fires are directional.

	5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m
<20mm	4.41E-10	4.41E-10	4.41E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20 to 100 mm	6.34E-10	6.34E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
>100 mm	2.10E-11	2.10E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Risk of fatality from flash fires (per m per yr)

	5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m
<20mm	1.46E-10	1.46E-10	1.46E-10	1.46E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20 to 100 mm	6.49E-10	6.49E-10	6.49E-10	6.49E-10	6.49E-10	0.00E+00	0.00E+00	0.00E+00
>100 mm	2.85E-10	2.85E-10	2.85E-10	2.85E-10	2.85E-10	2.85E-10	2.85E-10	0.00E+00

Risk of fatality from explosions (per m per yr)

	5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m
<20mm	1.62E-11	1.62E-11	1.62E-11	1.62E-11	5.67E-12	8.10E-13	1.62E-13	1.62E-14
20 to 100 mm	7.21E-11	7.21E-11	7.21E-11	7.21E-11	7.21E-11	7.21E-11	6.49E-12	2.16E-12
>100 mm	2.85E-11	2.85E-11	2.85E-11	2.85E-11	2.85E-11	2.85E-11	2.85E-11	1.76E-11

Total fatality (per m per yr)

	5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m
<20mm	6.0E-10	6.0E-10	6.0E-10	1.6E-10	5.7E-12	8.1E-13	1.6E-13	1.6E-14
20 to 100 mm	1.4E-09	1.4E-09	7.2E-10	7.2E-10	7.2E-10	7.2E-11	6.5E-12	2.2E-12
>100 mm	3.3E-10	3.3E-10	3.1E-10	3.1E-10	3.1E-10	3.1E-10	3.1E-10	1.8E-11
Total risk of fatality (per metre per year)	**2.3E-09**	**2.3E-09**	**1.6E-09**	**1.3E-09**	**9.4E-10**	**3.9E-10**	**3.2E-10**	**2.0E-11**
not taking into account any overlapping effect								

Divide pipeline into segments of 300 metres each.

In this particular case there is almost no overlapping of the effect zones, so no adjustment needs to be made for overlapping effect zones.

Total risk of fatality (per pipeline effect zone)		6.9E-07	6.9E-07	4.9E-07	3.9E-07	2.8E-07	2.3E-07	9.6E-08	5.9E-09
metres	0	5	10	20	30	50	100	200	300

Frequency of reaching 4.7kW/m2 (jet and flash)								
	5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m
	1.47E-09	1.47E-09	1.47E-09	1.47E-09	0.00E+00	1.46E-10	0.00E+00	0.00E+00
	2.55E-09	2.55E-09	2.55E-09	2.55E-09	2.55E-09	2.55E-09	0.00E+00	0.00E+00
	3.48E-10	3.48E-10	3.48E-10	3.48E-10	3.48E-10	3.48E-10	3.48E-10	3.48E-10
Total	**4.37E-09**	**4.37E-09**	**4.37E-09**	**4.37E-09**	**2.90E-09**	**3.04E-09**	**3.48E-10**	**3.48E-10**
Divide into segments of 300m each to account for any overlapping effects								
	1.31E-06	**1.31E-06**	**1.31E-06**	**1.31E-06**	**8.69E-07**	**9.13E-07**	**1.04E-07**	**1.04E-07**

	Frequency of reaching 23 kW/m2 (jet and flash)							
	5 m	10 m	20 m	30 m	50 m	100 m	200 m	300 m
	1.47E-09	1.47E-09	1.46E-10	1.32E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2.55E-09	2.55E-09	2.55E-09	2.55E-09	2.55E-09	0.00E+00	0.00E+00	0.00E+00
	3.48E-10	3.48E-10	3.48E-10	3.48E-10	3.48E-10	3.48E-10	3.48E-10	2.85E-10
Total	**4.37E-09**	**4.37E-09**	**3.04E-09**	**4.22E-09**	**2.90E-09**	**3.48E-10**	**3.48E-10**	**2.85E-10**
Divide into segments of 300m each to account for any overlapping effects								
	1.31E-06	**1.31E-06**	**9.13E-07**	**1.27E-06**	**8.69E-07**	**1.04E-07**	**1.04E-07**	**8.54E-08**

10 REFERENCES

1 Hazardous Industry Planning Advisory Paper No. 6 (HIPAP No. 6): *Guidelines for Hazard Analysis*, NSW Department of Planning

2 Hazardous Industry Planning Advisory Paper No. 4 (HIPAP No. 4): *Risk Criteria for Landuse Planning*, NSW Department of Planning

3 Hazardous Industry Planning Advisory Paper No. 6 (HIPAP No. 6): *Guidelines for Hazard Analysis*, NSW Department of Planning

4 Hazardous Industry Planning Advisory Paper No. 4 (HIPAP No. 4): *Risk Criteria for Landuse Planning*, NSW Department of Planning

5 Australian Standard AS2885.1-2001 and 2007 as relevant, *Pipelines – Gas and liquid petroleum*, Parts 1, 2 and 3

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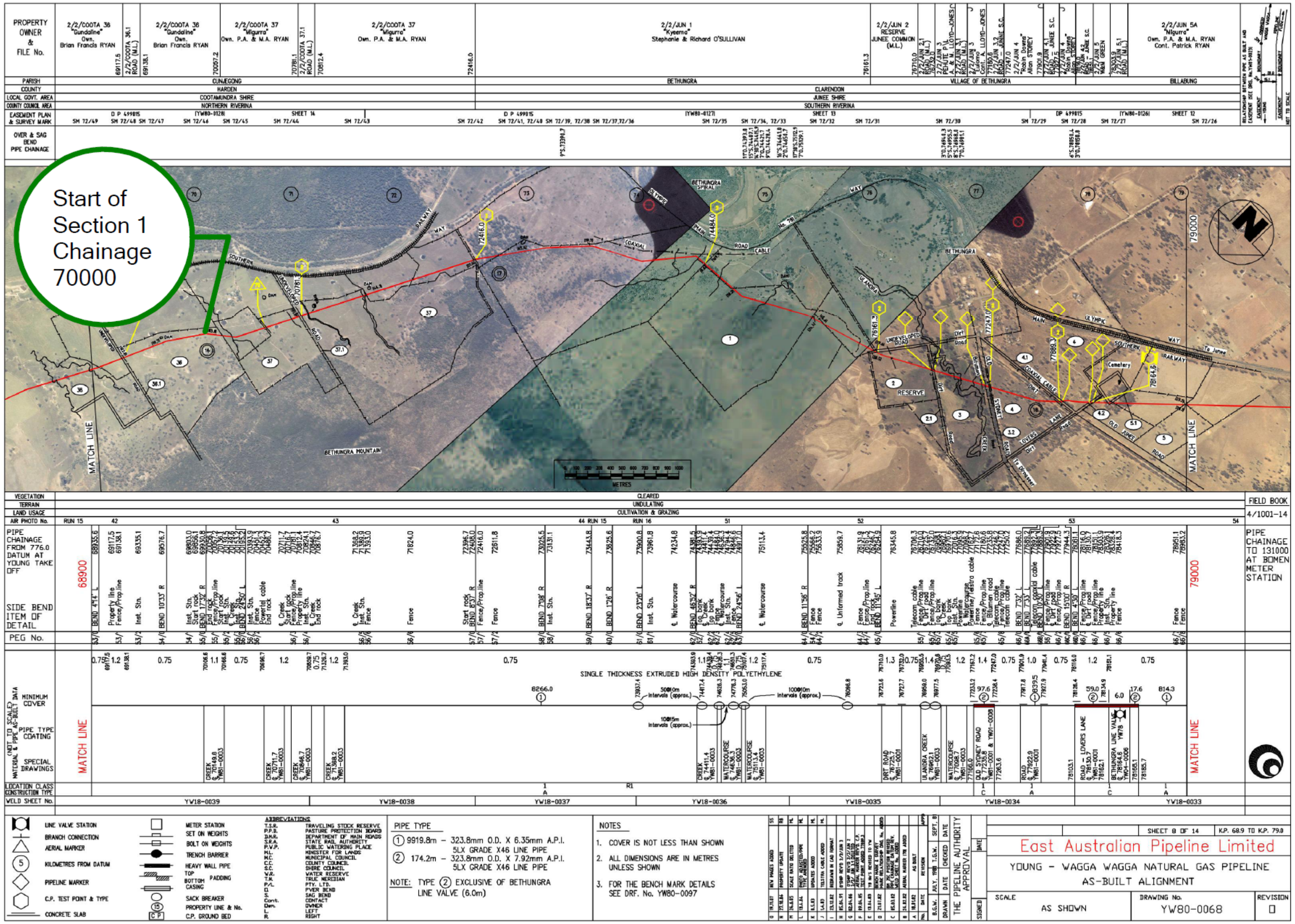
Sheet 1 (Drawing No. YW80-0068) of Young – Wagga Wagga Natural Gas Pipeline As-built Alignment (Source: APA). Start of study area indicated.



Sheet 8 (Drawing No. YW80-0074) of Young – Wagga Wagga Natural Gas Pipeline As-built Alignment (Source: APA). End of study area indicated.