Statement of validity

Submission of environmental assessment, prepared under Part 3A of the *Environmental Planning and Assessment Act 1979* and Regulation.

Environmental assessment prepared by

Name:	Emma Biddles Senior manager – environment
Qualifications:	BSc
Address:	Manidis Roberts Level 9, 17 York Street Sydney NSW 2000
In respect of:	Queensland Hunter Gas Pipeline Environmental Assessment

Applicant and land details

Applicant name:	Hunter Gas Pipeline Pty Ltd
Applicant address:	Level 1, 106 King Street, Sydney, NSW, 2000
Proposed development:	Construction and operation of a high pressure gas transmission pipeline from the NSW - Queensland border near Boomi to Newcastle, including a short pipeline lateral to the Maitland area. The Queensland Hunter Gas Pipeline would have an initial capacity of 85 petajoules per annum.
Land to be developed:	Land generally required for the construction and operation of the proposed Queensland to Hunter Gas pipeline, as shown in Chapter 4.

Environmental assessment

Statement of validity:	I certify that I have prepared the contents of the Environmental Assessment and to the best of my knowledge: • It is in accordance the Director-General's requirements dated 3 March 2008; and • The information contained in the document is neither false nor misleading.
Signature:	
Date:	8 September 2008

Executive summary

Overview

The Queensland Hunter Gas Pipeline (QHGP) is a critical energy infrastructure project to deliver competitively priced coal seam gas (CSG) from south east Queensland to meet the growing demand for gas in the Hunter and Newcastle industrial regions. The QHGP has been developed to provide greater security of gas supply to Newcastle, Sydney and New South Wales (NSW). This facilitates the delivery of gas to areas where it is currently not available and enables more choices for consumers in the NSW energy market. It also frees up existing gas supplies for use in the Sydney area.

The QHGP proposal involves the construction and operation of a gas transmission pipeline, primarily for CSG or natural gas, from near Wallumbilla in Queensland (500km west of Brisbane) to Newcastle in NSW. The pipeline would be approximately 825km in length, with 603km of the pipeline being located in NSW and the remainder in Queensland. A short lateral in the Maitland area of approximately 10.5km is also included in the proposal. The pipeline would traverse the local government areas (LGAs) of Moree Plains, Narrabri, Gunnedah, Liverpool Plains, Upper Hunter, Muswellbrook, Singleton, Maitland, Port Stephens, and Newcastle. The pipeline would be buried for its entire length within a 30m wide easement (right of way, ROW). Ancillary aboveground facilities and line markers would be the only features on the surface.

Hunter Gas Pipeline Pty Ltd is the proponent for the proposal. The proposal would be privately funded.

The Queensland portion of the QHGP has been approved and a pipeline licence granted effective 1 May 2007. Approval of the NSW portion of the QHGP is now being sought under Part 3A of the *Environmental Planning & Assessment Act 1979* (EP&A Act). This Environmental Assessment (EA) has been prepared as part of a submission to the NSW Department of Planning (DoP) for approval of the QHGP.

The Minister of Planning has declared the QHGP to be a ‘critical infrastructure’ project (gazetted 13 June 2008) as it is essential to NSW for economic, environmental and/or social reasons. The proponent is seeking approval under Section 75P(1)(c) of the EP&A Act.

The 200m wide Study Area for the QHGP is shown in Figure ES-1.

Drawing no. 07002g_CP_ES_01-1

Date 02 September 2008

Source Geoscience Australia
NSW Dept Env. & Climate Change
RLMS Pty Ltd

Datum GDA 94

Legend

Kilometre point	Populated place
Study Area	Main road
National Park	Railway
Ramsar sites	Major river
	State border

Queensland Hunter Gas Pipeline

Executive summary QHGP Study Area

0 20 40 60 80km

Strategic context and need for the proposal

The QHGP aims to deliver increased competition and security of gas supply to support regional development in NSW. It is economically significant for the Hunter and Newcastle regions because it accesses CSG reserves in south east Queensland. It also increases the potential for exploration and development of CSG reserves in northern NSW. In the strategic context of existing and emerging challenges within the NSW gas and energy markets, future economic growth and NSW Government policy priorities, there is a need for the QHGP proposal.

Safeguarding gas supply

NSW is unique among mainland states as it currently does not have large commercially viable natural gas reserves and therefore traditionally relies on importing gas from the Cooper Basin (South Australia) and more recently Bass Strait (Victoria).

The QHGP would diversify gas supply to the NSW market reducing the impact of operational, strategic and long-term risks to the continuity and security of supply.

The NSW gas market has been impacted by critical events on the supply network such as the load-shedding event in the Moomba to Sydney Pipeline in June 2007, which resulted in a NSW Government inquiry, the *Report of the Owen Inquiry into Electricity Supply, 2007* (Owen Inquiry).

The Owen Inquiry identified that additional pipeline capacity would be required to meet the forecast gas demand requirements of NSW. The QHGP provides this vital missing link in the gas transmission network, connecting the NSW gas market to world class reserves of CSG in south east Queensland.

Background studies undertaken as part of the Owen Inquiry have forecast that CSG production potentially could account for more than 50 per cent of total gas supply in eastern Australia by the end of the next decade. North eastern NSW contains significant sedimentary sequences, which are expected to have significant potential gas reserves, both conventional and coal seam. The QHGP would offer transmission to key industrial and commercial centres creating increased potential for the exploration and commercial operation of a number of these reserves.

Providing a competitive gas market

Despite the limited diversification of gas supply, to date delivered gas prices in NSW have remained relatively immune to significant price increases. However, with the declining Cooper Basin production and growing gas demand, the potential for shortage of gas supply could result in significant increases to gas prices. By enabling access to additional gas supplied from Queensland, the QHGP would have a positive competitive impact on both delivered gas cost and long-term supply availability for NSW users – households, industry and electricity generators. Recent transmission tariff reductions on existing pipelines demonstrate this.

Economic benefits

The direct and indirect economic benefits of the QHGP to NSW are significant. The proposal is expected to make a much greater indirect contribution to NSW's economy through the expansion of industry and job creation throughout regions which the pipeline supplies, particularly the Hunter and Newcastle regions. Provision of competitively priced gas to meet growth in gas demand would enable additional investment in existing and emerging industry and gas-fired electricity generation. This is already accelerating the development of CSG reserves in northern NSW along the pipeline route. These indirect benefits are expected to have an economic multiplier effect.

Greenhouse benefits and electricity

The relatively high per capita greenhouse gas emissions in NSW are primarily due to the state's high dependence on coal-fired electricity generation. Around 47 per cent of all greenhouse emissions in NSW result from electricity generation and around 91 per cent of NSW electricity supply currently comes from coal-fired generation (NSW Greenhouse Plan 2005). The Owen Inquiry found it is likely that new generation capacity will be required in the State within the period 2013 to 2017.

Diversifying the State's energy generation mix by reducing reliance on coal-fired generation and by increasingly meeting demand through gas-fired generation (which produces on average less than half of the carbon emissions of new coal-fired power stations) would make a material contribution to meeting the NSW Government's greenhouse gas emission reduction targets, as well as providing new base load capacity. When potential future carbon prices are factored into the cost of electricity generation, it is expected that gas-fired generation will become increasingly competitive to that of coal-fired generation. The QHGP has the potential to positively influence investment in gas-fired generation technology through access to competitively priced delivered gas.

Government policy objectives

The QHGP is consistent with and contributes to the achievement of a range of government policy objectives and priorities, including:

- The *NSW State Plan* regarding regional development, energy and related resource sectors.
- The *NSW Greenhouse Plan 2005* which sets reduction targets of year 2000 levels by 2025 and 60% by 2050.
- The *State Infrastructure Strategy* which identifies that a reliable and competitive electricity sector is essential to ensure NSW's economic competitiveness, economic growth and need for new base load capacity in the medium term to meet rising demand.
- The *Lower Hunter Regional Strategy* which provides a framework for regional growth over the next 25 years, including the need for a secure and affordable energy supply to regional industry.

Development of the pipeline route

The development of the pipeline route was underpinned by principles of ecologically sustainable development (ESD). These principles are reflected in the design philosophy of avoiding areas of high biodiversity and cultural heritage value and a preference for running the pipeline through already disturbed areas. The careful selection of the preferred route was undertaken over a number of years and based on a filtered approach to progressively identify and then avoid regional and localised constraints.

A 200km wide corridor was initially established around a line extending directly from Wallumbilla to Newcastle. Four general route options, each 20km wide, were developed within this broad corridor to avoid regional constraints. A study area 200m in width (Study Area) within which the pipeline final ROW would be located was defined. This Study Area would provide sufficient flexibility for the ROW alignment to avoid local constraints whilst allowing for a practical scale for environmental assessment.

The nature of pipeline design and construction requires some flexibility in final route alignment. The route would continue to be refined as a result of ongoing stakeholder, landholder consultation and fieldwork. The final route alignment targets an area 30m wide for the proposed construction ROW and operations easement.

Description of the Study Area

The Study Area is predominantly located in agricultural areas, avoiding interactions with environmentally and culturally sensitive areas, built up areas, mountainous terrain, and other regional and localised constraints. As part of an overall design philosophy to avoid known sensitive areas, there has been a preference for the QHGP to go through disturbed (private agricultural) lands and avoid Travelling Stock Reserves (TSRs).

The QHGP traverses a wide variety of natural environments including the Liverpool Ranges, a number of major highways and rivers.

In the northern regions of the Study Area, such as around Moree and Boomi, cotton production is the primary land use, whereas towards the south, in the Hunter region, agricultural lands within the Study Area are more generally used for grazing. Both of these activities are compatible with the operation of a gas pipeline.

Proposal description

The QHGP would be designed and constructed in accordance with the current version of *AS2885 Pipelines Gas and Liquid Petroleum.* In addition to meeting regulatory requirements and guidelines, the proponent has drawn on the *Code of Environmental Practice, Onshore Pipelines* developed by the Australian Pipeline Industry Association (APIA, 2005). As a result, measures to reduce potential impacts of the pipeline are inherent in the design, construction and operation procedures.

Pipeline design

The pipeline design ensures that risks are mitigated through specifications such as wall thickness, depth of cover, selection of materials, corrosion protection, signage and integrity monitoring. The pipeline would be made of carbon steel and have a diameter of approximately 500mm.

Pipeline construction activities

Pipeline construction involves a repetitive sequence of a number of activities which must be carefully planned, scheduled and integrated to function as a continuous production process, including: survey and fencing, set up of temporary facilities, clear and grade of the ROW, trenching, pipe stringing and bending, pipe welding and inspection, joint coating, pipe placement, backfilling and compaction, hydro-testing, and reinstatement. Each activity has a nominated crew composed of personnel and equipment required to carry out the task.

Blasting would be required to form the trench in areas of hard rock. This is anticipated to total less than eight per cent (45km) of the length of the pipeline and would be concentrated in the Liverpool Ranges and in some areas on the northern edge of the Hunter Valley region.

Horizontal boring would be used for infrastructure crossings, such as major roads and railways. Specialist techniques, including horizontal directional drilling (HDD), would be used for major watercourse crossings, such as the Hunter River.

The pipe would be transported progressively in stages by road and/or rail to storage facilities located to the north and south of the Liverpool Ranges. Pipe would be delivered from the storage facilities to the ROW by truck.

Local contractors and service companies would be involved with the construction phase where practicable. However, some aspects of the construction process require specialist pipeline/technical expertise, which may not be available in local areas. The construction workforce would most likely be housed in temporary, self-sufficient construction camps equipped with modern amenities. It is estimated that each spread would utilise one construction camp during the construction period.

Other activities during construction

The *Pipelines Act 1967* requires the proponent to obtain an interest in all the land comprising the pipeline route, which is normally in the form of a negotiated easement over the 30m ROW. The proponent is currently consulting with landholders along the Study Area.

During construction, access tracks would be required to the pipeline ROW, facility sites and campsites. Existing roads, tracks and disturbed areas would be utilised as far as practicable to minimise disturbance to landholders and environmentally sensitive areas.

Commissioning activities

Once installed, the pipeline is hydrostatically tested to prove its integrity. Clean up and reinstatement measures would be undertaken following completion of construction. Pipeline marker signs would be installed to indicate the presence of the pipeline to reduce the risk of inadvertent damage by third parties. Aspects of the hand over commissioning include instrument calibration, performance testing and a baseline condition assessment.

Operational activities

Routine operation and maintenance programs involve ground and aerial patrols, repair of equipment, cleaning of the pipeline, monitoring for corrosion and ROW maintenance. Aerial and/or ground inspections include detection of erosion, monitoring of reinstatement success, and detection and control of weed species. The pipeline would have a cathodic protection (CP) system, which would be checked regularly to ensure the protection voltages are within limits and to monitor any likely areas of corrosion activity.

All gas flows would be metered with high accuracy metering and continually checked against the volume of gas within the pipeline. Any major imbalance would be immediately checked to confirm the integrity of the pipeline.

Community and stakeholder consultation

A diverse range of people and organisations with differing needs, interests and responsibilities in relation to the QHGP have been consulted. They include communities, individual landholders, government departments, statutory bodies, local councils, elected representatives, utilities, infrastructure owners, Aboriginal groups, potential customers and special interest groups.

An integrated stakeholder consultation process has been, and continues to be, a central pillar of the proposal and would be ongoing through to construction and operation. An inclusive approach has been taken that aims to foster an open and transparent flow of information and feedback between the proponent and stakeholder groups, with varying techniques being used to meet the needs of different stakeholders. Implementation of the stakeholder engagement plan commenced in November 2007 and has included a variety of written material, presentations, meetings, letters, phone calls, media outreach and a dedicated QHGP website (www.qhgp.com.au) which is a further source of information on the proposal. Stakeholder feedback continues to influence and shape the route alignment.

The proponent intends to establish a framework for ongoing liaison with representatives of Department of Environment and Climate Change (DECC), Department of Primary Industries (DPI), Department of Water and Energy (DWE), DoP and other relevant agencies.

Statutory requirements

As the QHGP is located partially within NSW and partially within Queensland, it is subject to statutory requirements in both States and at the Commonwealth level.

NSW

The QHGP proposal is a major infrastructure project under Part 3A of the EP&A Act. On 11 February 2008, the Minister for Planning authorised Hunter Gas Pipeline Pty Ltd to lodge a concept plan for the QHGP. This EA addresses the key environmental issues associated with the proposal and includes mitigation and management measures to address potential impacts.

The QHGP proposal has also been accorded critical infrastructure status (gazetted 13 June 2008) under Section 75C of the EP&A Act as, in the opinion of the Minister for Planning, the proposal is essential to NSW for economic, environmental and/or social reasons.

The proponent is seeking approval by the Minister for Planning under Section 75C(1)(c) of the EP&A Act, with no further assessment requirements for the QHGP or any particular stage of the QHGP.

Queensland

The QHGP has received relevant statutory licences and approvals in Queensland.

Commonwealth legislation

The proposal is subject to the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). A referral to the Commonwealth Minister for the Environment, Heritage and the Arts will be lodged in September 2008 in respect of matters of ‘national environmental significance’ (NES) interacting with the proposal.

Environmental assessment process

The outcomes of an environmental risk analysis conducted for the proposal has shown that the majority of potential impacts are associated with the construction phase, so are temporary and localised to the period of transient construction activity in an area. In general terms, ongoing operation of the pipeline would have negligible environmental impacts.

The overriding objectives of the EA, have been to identify, as far as possible:

- Key issues likely to provide substantial constraints and which may require field investigation during the ongoing refinement of the proposal and/or the preparation of issue or area specific management and mitigation strategies.

- Other issues and areas that can be managed by industry standards and widely accepted management and mitigation approaches.

The EA has deliberately adopted a precautionary approach, whereby any issues that are sufficiently unclear and/or may result in potential impacts of significance have been identified for field focused investigations. Therefore, key issues have been subject to a tiered assessment of impacts using a set of tailored significance criteria for each issue, as outlined below.

Key issues

Biodiversity impacts

Overall, the Study Area has specifically avoided areas of conservation significance and has been cognisant of other key biodiversity features, utilising areas of cleared or degraded lands wherever possible as a means of reducing impacts to biodiversity.

Vegetation

Within the broader regions of the Study Area, native vegetation is often fragmented, with isolated patches scattered throughout the landscape, particularly along riparian corridors and within TSRs. These patches of vegetation often represent significant biodiversity conservation value, often within a landscape characterised by cleared agricultural lands. The proposal has the potential to result in a decrease in the extent and quality of a number of endangered ecological communities throughout the Study Area due to vegetation clearance, and additional indirect impacts such as increased weed invasion. Targeted field investigations of these communities would optimise the final ROW with a view to avoiding direct impacts wherever possible. Where impacts on these communities are unavoidable offsets are being considered to ensure that there is no net loss of biodiversity values. The requirement for an offset strategy will be determined in consultation with DECC and other relevant agencies. Specific management measures, in addition to industry standard environmental management controls, would also be implemented to prevent any potential indirect impacts on those communities within the Study Area.

Fauna

The Study Area is expected to provide habitat for a number of threatened fauna species, including rock dwelling reptiles, arboreal mammals, ground dwelling mammals, and bird species. The condition and extent of this habitat would be further examined during the detailed design and ROW finalisation of the proposal to ensure that any direct impacts to these habitats is minimised. In addition, specialist personnel would be used to ensure that construction activities do not directly impact on any of these threatened species, in areas identified as potential habitat. Stringent mitigation and management measures, in conjunction with specific work procedures would be implemented during construction to minimise impacts. Following construction, a program of reinstatement and rehabilitation would be developed to ensure vegetation can re-establish across the ROW, and impacts from weed establishment can be minimised.

Aquatic species

A number of threatened aquatic species, and an aquatic endangered ecological community, are also expected to occur within the Study Area. Management measures have been developed to mitigate any potential adverse impacts.

Heritage impacts

Indigenous Heritage

Comprehensive consultation with Aboriginal stakeholders is being undertaken in accordance with the DECC, *Interim Consultation Requirements for Applicants* (2004). This consultation is extensive and ongoing. A search of the DECC Aboriginal Heritage Information Management System data identified four known sites of high cultural significance within the Study Area. The assessment has shown that as the ROW alignment would avoid these sites, there would be negligible impacts. Predictive modelling based on bioregions identified additional types of sites and items that may be encountered during construction. Potential impacts to any of these would be managed by measures appropriate to the type and significance of the site or item, including field investigation to determine avoidance or management measures. In addition, cultural heritage management measures, such as research based excavations and Aboriginal community involvement, would further minimise the risk of disturbance to heritage items and places during construction and operation.

Historical heritage

There are 20 known historical heritage items located within the Study Area. The proposal would avoid direct impacts on all of the known heritage items. During detailed design, heritage items and places would be further investigated and those affected by the final ROW alignment would be identified. Any residual heritage constraints would be assessed in detail to determine avoidance or management measures. It is unlikely that extensive mitigation measures would be required as the QHGP has specifically sought to avoid historical heritage constraints through the route selection process.

Human amenity impacts

A geographic information system (GIS) analysis was undertaken to characterise the range of human receptors along the Study Area in order to consider potential impacts on human amenity. An ongoing consultation program would ensure any potentially impacted residences would be identified.

Noise vibration and blasting

For the majority of its length, the pipeline would be located away from populated centres and rural residences. Noise impacts would primarily be generated by bulk excavating machinery, such as bulldozers and chain or wheel trenchers and blasting. Receivers would only be affected during construction activities. Pipeline construction is transient in nature, whereby construction crews complete specific activities intermittently along the ROW. The noise assessment adopted a tiered impact assessment to determine noise offset distances and identify potential noise receptors within the offset region. For major noise impacts, an offset distance of 350m for isolated residences and 250m for township receivers was used. Noise and vibration impacts as a result of the proposal during construction are unlikely to be significant, and would be manageable through the implementation of standard mitigation measures. Central to the management and mitigation of noise impacts would be the implementation of an extensive consultation program.

During operation, noise and vibration impacts would be minimal and would generally be limited to necessary maintenance activities.

Air quality

The principal emissions from construction activities would be dust from earth moving activities and transport on unsealed roads and tracks during dry conditions. The extent of the impact would vary depending upon soil type and the prevailing wind conditions at a given location. Appropriate mitigation measures would be implemented to minimise the potential impact from dust and particulate matter.

During operation, as the pipeline would be buried and maintenance activities are generally passive, air quality would be unlikely to be affected. The ROW would be rehabilitated after construction thereby minimising the potential for dust generation.

Traffic and transport

Roads likely to be utilised by the QHGP vary from minor rural roads to major highways. Construction would involve both the transport of plant equipment and materials on the road network and the installation of the pipe, across and within road reserves. Mitigation measures would include scheduling construction activities appropriately to avoid peak times. The delivery of pipe would be distributed along the length of the route resulting in a limited number of truck movements in any one location. Detailed design and ongoing consultation with infrastructure owners/managers would inform traffic management treatment (such as localised traffic impacts and road crossings) and is therefore considered an ongoing process which would be defined prior to construction.

Socio-economic impacts

The overall investment in the pipeline is expected to result in around $600 million of direct investment into NSW and create up to 600 jobs during construction and 25 direct permanent jobs during operation.

The construction phase of the proposal is not anticipated to have any long-term negative impact on demographic change, development demand or local employment within the regions. Local communities would benefit from the presence of the construction workforce due to increased demand for goods and services such as food and fuel supply and equipment hire.

Economic impacts during construction include privacy and access for individual landholders, compensation and easement acquisition, employment, and local economic activity. Landholders directly impacted by construction would benefit from compensation for the creation of the easement on private lands.

Land use impacts

The assessment of potential land use impacts included the identification and review of potential conflicts with existing and future uses, with particular emphasis on urban and agricultural land uses and extractive industries. The proposal is generally consistent with the existing statutory land use frameworks along the Study Area. Mitigation and management measures include aspects of the design and construction methodology that are specifically aimed at avoiding any potential land use conflicts through continually optimising the alignment of the pipeline ROW.

Hazard and risk assessment

A preliminary risk assessment was carried out based on provisional design details and typical pipeline safeguards. Potential hypothetical hazards arising from the QHGP design, construction, commissioning and operational stages were identified and qualitatively assessed using the methodology of *AS2885 - Pipelines Gas and Liquid Petroleum* and quantitatively assessed using the methodology *of NSW Department of Planning Hazardous Industry Planning Advisory Paper* (HIPAP) *No. 6* and the risk criteria given in *HIPAP No. 4* (DoP, 1992).

The qualitative assessment concluded there were no ‘extreme’ or ‘high’ risk level incidents. Other risk level incidents ranged from ‘negligible’ to ‘intermediate’. The most rigorous level was adopted for the quantitative risk assessment and showed the main hazard of concern is a loss of containment during operation, release of high-pressure CSG to the environment and subsequent ignition. A range of typical safeguards and additional risk reduction measures would be incorporated in the final design and the assessments updated.

Surface and groundwater impacts

Based on available data sources, all watercourses that would be intersected by the Study Area were identified and categorised according to their sensitivity. The Study Area crosses a total of 176 waterways including the Gwydir, Boomi, Quirindi, Hunter, Macintyre/Barwon, Namoi and Pages systems. Kooragang Island Nature Reserve and the upper catchment of the Gwydir Wetlands have also been identified as being of high sensitivity with potential to be impacted by the proposal. The majority of crossings are through non-perennial watercourse features (intermittent flow). The two main methods of crossing a watercourse are open cut trenching (with or without flow diversion) and HDD. The Hunter River would be crossed using HDD at two places, KP812 and KP816. Due to the variability of site conditions, particularly flow regimes of a watercourse at the time of construction, the appropriate watercourse crossing technique, location and site specific management measures would be determined closer to the time of construction. The proponent would consult with DECC, DPI and DWE in relation to crossing methods and site specific management measures for high sensitivity watercourses. Potential impacts to groundwater and perennial watercourses include changes in waterway channel or bank form, pollution of surface and groundwater, and changes to existing surface flow regimes. There were no impacts identified to drinking water sources or groundwater reserves. In most cases, surface water and groundwater can be managed through the implementation of standard mitigation and management measures.

Infrastructure impacts

Infrastructure potentially impacted by the QHGP includes major highways, roads, railways, electricity transmission lines and other pipelines. Potential impacts on infrastructure have been assessed by consulting the relevant stakeholders to determine their requirements and developing the design accordingly. Each crossing design would be refined further in consultation with the relevant asset owner and/or manager during detailed design.

Other issues

A number of other environmental issues have been identified that are considered relevant to the proposal:

- Resource (energy and water use) and waste management.
- Contaminated land.
- Geology and soils.
- Visual amenity.
- Greenhouse gas and emissions.
- Cumulative impacts of major developments.

A hydrostatic water plan would be prepared prior to construction activities to determine the potential quantities of water that would be used. Principally, the extraction of hydro-test water would be in compliance with regulatory and landholder requirements and the test water would not be directly discharged to watercourses.

Impacts of other issues during construction are temporary and localised. The potential impacts of these issues are manageable through standard management and mitigation measures, during either construction or operational management.

Adaptive management of environmental constraints

The ongoing design philosophy for the QHGP reflects a precautionary approach to the management of environmental risks by adopting a hierarchy of avoid, mitigate and offset. **It is important to note that the proposal has the flexibility for the ROW to avoid direct impacts on most known issues. The philosophy of avoidance is central for ongoing environmental management, as information is continually taken into consideration, collated and analysed during design and construction.** Therefore, greater clarity and understanding of specific impacts would be progressively realised through fieldwork, informed by seasonal and site specific conditions in the field, to continue to develop the ROW alignment. This fieldwork is principally related to biodiversity and heritage issues.

Statement of Commitments

Draft Statement of Commitments (SoC) have been developed which the proponent would undertake in guiding the ongoing development of the proposal to minimise environmental impacts.

Proposal justification and conclusion

The proposal is consistent with State objectives by contributing to the security of gas supply and the cost effective provision of a cleaner energy source for the NSW market as well as increased business investment, jobs creation and the achievement of broader economic and environmental goals.

This EA has endeavoured to address potential environmental impacts of the QHGP through the design, construction, and operation phases. The assessment of the potential impacts of the QHGP is consistent with the precautionary principle and considers the impacts and benefits in terms of the principles of intergenerational equity.

The assessment of key environmental impacts is consistent with robust scientific and professional methodologies. Extensive consultation with key stakeholders has also been undertaken to feed directly into the assessment process with a view to further defining potential impacts and mitigation measures. The development of mitigation and management measures has also been a key feature in the preparation of this EA and firm commitments to implement mitigation measures and undertake further investigations have been proposed in the draft SoC.

The QHGP would provide a vital missing link in the eastern Australian gas distribution network. It would serve to connect the NSW gas market to world-class reserves of CSG in Queensland providing additional supplies to that already sourced from interstate. Direct and indirect economic benefits associated with the QHGP would be significant. On balance, the weight of benefits to NSW and the eastern Australian gas market associated with the QHGP are compelling.

1 Introduction

This chapter provides an outline of the Queensland Hunter Gas Pipeline (QHGP) proposal. It includes a general overview of the proposal, a summary of the proposal's status and previous work that has been conducted, an outline of the environmental assessment (EA), and a synopsis of its structure.

1.1 Proposal overview

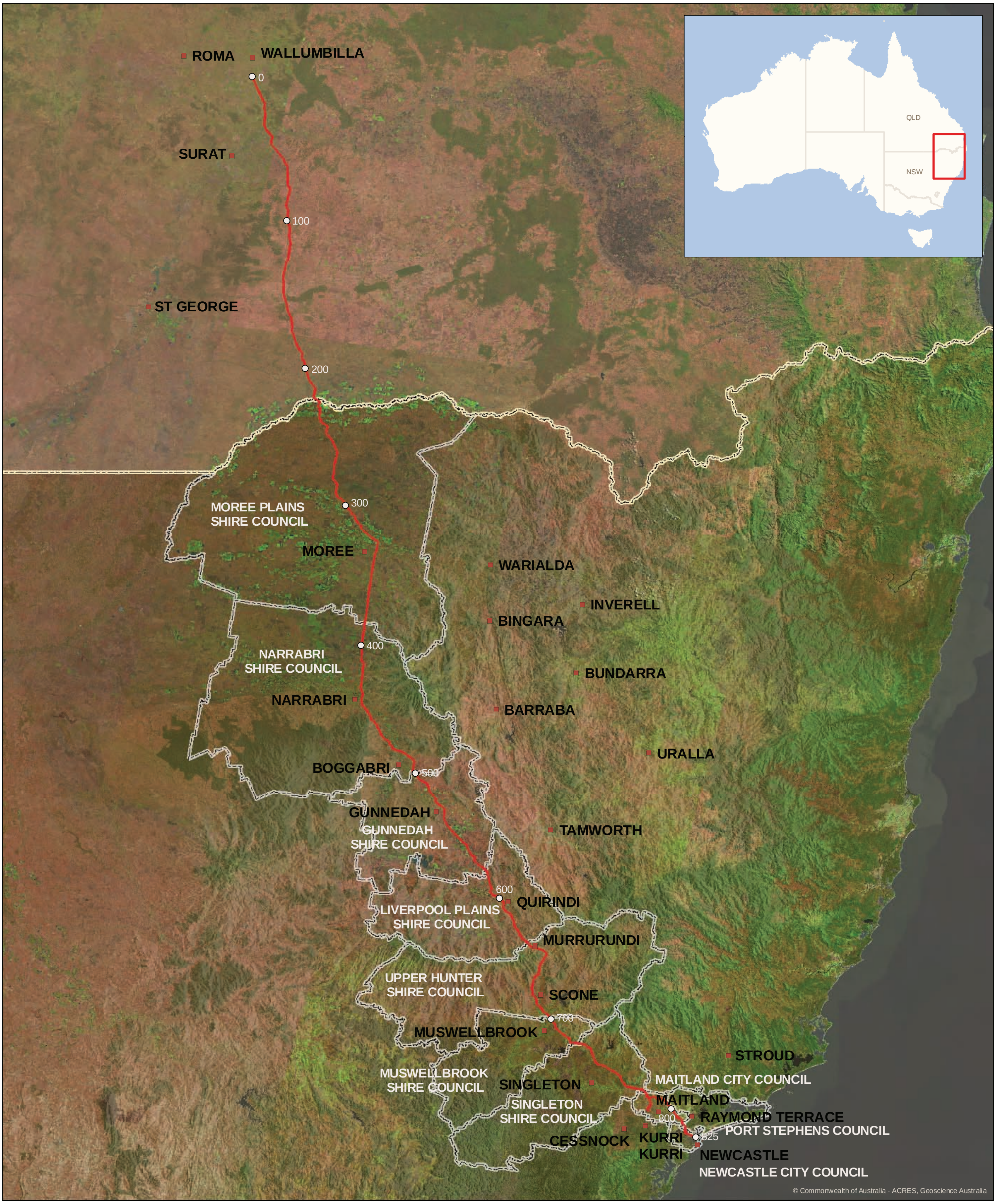
The QHGP is a proposal to construct a gas transmission pipeline primarily for coal seam gas (CSG), but would also be suitable for natural gas, from near Wallumbilla in Queensland (500km west of Brisbane) to Newcastle in New South Wales (NSW) (refer to Figure 1.1). The pipeline would be approximately 825km in length, with 603km of the pipeline being located in NSW and the remainder in Queensland. In addition, a short lateral in the Maitland area of approximately 10.5km is also included in the proposal. The pipeline traverses the local government areas (LGAs) of Moree Plains, Narrabri, Gunnedah, Liverpool Plains, Upper Hunter, Muswellbrook, Singleton, Maitland, Port Stephens, and Newcastle.

The pipeline would be buried for its entire length and would be identified with line of sight markers positioned clearly on the pipeline easement. Facilities such as isolation valves, meters, and regulators would be the only infrastructure features above ground.

The instrument for the acquisition of the pipeline land is a registered easement. Generally a 30m corridor would be required for the length of the pipeline. This width would be refined by taking into consideration land use, environmental, technical and economic elements, and consultation with affected stakeholders.

The Minister for Planning has declared the QHGP to be a critical energy infrastructure project (gazetted 13 June 2008) as in his opinion the proposal is essential to NSW for economic, environmental, and/or social reasons. It would provide additional capacity to meet the growing demand for gas in the Hunter Valley's industrial region. It would also provide a more secure supply to the Hunter region and potentially deliver gas to areas of NSW where there is currently none available. The proposal is privately funded.

Once it is operational, the pipeline would provide supplementary gas supplies to the Newcastle region. Therefore, this would help to create greater choice and more competitive pricing for consumers in the NSW energy market. The pipeline also has the potential to stimulate industry and create employment.



Drawing no. 07002g_CP_24-1

Date 01 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Populated place
- State border

Queensland Hunter Gas Pipeline

0 20 40 60 80km

Figure 1.1 QHGP Study Area

1.2 The proponent

The QHGP is a proposal by Hunter Gas Pipeline Pty Ltd, a private company comprising prominent Australian businessmen with extensive experience in the resource industry. The company's business objective is to deliver competitively priced gas supply to NSW.

Its directors are:

- **Chairman – Duncan Hardie:** Duncan Hardie is one of the joint founders of Hunter Gas Pipeline Pty Ltd. Duncan has been involved in the development of the Hunter Economic Zone (HEZ). Duncan is also the founding director of Hardie Holdings Pty Ltd and has over 40 years experience in property development, management and investment in the industrial, commercial, residential, and retail sectors.
- **Managing Director – Garbis Simonian:** Garbis Simonian is the founder of Weston Aluminium Pty Ltd. His successful business career includes Kaleej International and companies involved in property development, air freight forwarding and motor vehicle parts importing. In 1993, he was appointed as Executive Director of Mino Metal Pty Ltd, trading in nonferrous metals. Soon after he became the Managing Director of Alumino Australia Pty Ltd. In 1996, Garbis established Weston Aluminium Pty Ltd, a services company that provides innovative solutions to the aluminium and steel industries.
- **Director – Hilton Grugeon:** Hilton Grugeon is perhaps best known for his involvement with Hunter Land, a local development company responsible for industrial, commercial and residential developments. He has been involved in development for over 25 years. Hilton also has interests in a wide range of manufacturing, service and retail businesses.
- **Director – Ross Skerman:** Ross Skerman is a geologist with over 35 years of oil and gas industry experience predominantly with Delhi Petroleum, operator of the Cooper Basin, based in Adelaide. In 1985, Ross relocated to Brisbane to manage Delhi's presence in Queensland focusing on the South West Queensland Gas development. For the past 18 years, Ross has been Principal of Resource and Land Management Services Pty Ltd (RLMS), a resource industry consultancy specialising in pipeline development, corridor mapping, environmental approvals, and land acquisition.

Contact details are as follows:

- Email: contact@qhgp.com.au
- Phone: (02) 9411 4294
- Post: Queensland Hunter Gas Pipeline, PO Box 5523, West Chatswood NSW 1515

1.3 Background to proposal

1.3.1 Proposal history

The current proposal builds on an earlier proposal in relation to the pipeline, and addresses issues raised by the Department of Planning (DoP) in connection with the initial proposal.

The history of the initial proposal in relation to its planning and approval is as follows:

- Proposal commenced under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).
- Planning focus meeting on 20 February 2006.

- DoP Director-General requirements under Part 5 issued 30 March 2006.
- Applied for project approval under Part 3A of the EP&A Act on 17 October 2006.
- Director-General environmental assessment requirements (DGRs) under Part 3A issued 14 November 2006.
- Draft version of the EA issued to the DoP on 8 December 2006 for a review of adequacy.
- Comments from the DoP, the Department of Environment and Climate Change (DECC, previously known as the Department of Environment and Conservation), the Department of Natural Resources (DNR) and the Department of Primary Industries (DPI) received in January/February 2007.

Comments received from NSW government departments and agencies on the initial proposal highlighted concerns relating to the route alignment and selection, lack of conceptual design of the pipeline including a framework for detailed design, and the need for a systematic approach to the EA.

It was identified that the initial proposal, as at the beginning of 2007, required the following additional information, development and/or further information:

- A review of key issues relating to the proposal.
- Key 'fundamentals' for the proposed pipeline, including engineering requirements and the proposed route alignment.
- The basis for the route alignment and selection, which is the premise for the pipeline to be assessed.
- The most appropriate and risk adverse planning approvals pathway.
- The methodology within which the proposal could be undertaken, which in turn would influence engineering, social, environmental and planning considerations.

In May 2007, a revised project team, proposal alignment and approvals approach for NSW was developed to address these issues. In so doing, the project team liaised with DoP and relevant departments and agencies as described in Chapter 7. This EA represents the culmination of the further work in developing and refining the proposal and the assessment and approvals approach.

The Queensland portion of the QHGP has been approved and a pipeline licence granted effective 1 May 2007.

1.3.2 Project team

The project team currently working on the design, assessment and approval documentation for the proposal are:

RLMS

RLMS is responsible for the approval and licensing of the Queensland portion of the QHGP. RLMS are also working on the route selection and landowner consultation for the NSW portion of the pipeline, and providing specialist support in relation to pipeline construction impacts.

URS

URS Australia Pty Ltd is responsible for preliminary engineering design of the QHGP.

Manidis Roberts

Manidis Roberts is responsible for the approval under the provisions of the EP&A Act and regulations for the construction of a pipeline in NSW.

1.3.3 Approval process for critical infrastructure project

The declaration of the QHGP as a critical infrastructure project under Section 75C of the EP&A Act recognises the strategic significance of the proposal as essential to the State of NSW for economic, environmental and/or social reasons. The stated aim of critical infrastructure project status is to:

- Ensure the timely and efficient delivery of essential infrastructure projects.
- Allow the government and the planning system to rapidly and readily respond to the changing needs of the State.
- Provide certainty in the delivery of projects.
- Provide rigorous scrutiny to ensure environmental outcomes are appropriate.
- Focus on delivering outcomes essential to the NSW community.

The EP&A Act provides a framework for environmental planning and assessment in NSW. Part 3A provides for an integrated and streamlined assessment and approval process for major infrastructure projects, and allows for different levels of assessment and approval as appropriate depending on the particular project, as follows:

- Project application, assessment and approval.
- Concept plan application, assessment and approval followed by project application, assessment and approval.
- Combined concept plan and project application, assessment and approval.
- Concept plan application, assessment and approval followed by subsequent assessment under Part 4 or 5 of the EP&A Act.
- Concept plan application, assessment and approval – no further assessment required for the project or any particular stage of the project.

The proponent is seeking approval of the last listed type, under Section 75P(1)(c) of the EP&A Act, based on the following considerations:

- Consistency with the aims of critical infrastructure projects proceeding with increased certainty and reduced potential for delay.
- The potential impacts of the proposal would be largely associated within the short-term, localised nature of construction rather than the pipeline's long-term operation.
- The dynamic field conditions at the time of construction necessitate an adaptive management approach, rather than further assessment studies that are unlikely to reveal the pipeline corridor conditions at the time of construction.
- A separate project approval would have limited value as the nature of the proposal is such that the potential for specific impacts are dependent on and can only be realised within the context of the seasonal and specific conditions in the field closer to the time of construction.
- The proponent would formalise a protocol for a government liaison group and would consult regularly with relevant departments and agencies in relation to more targeted and specific measures to suit the field conditions at the time of construction.
- The opportunity for the proponent to address any residual issues through requirements of the Director-General of DoP under Section 75H(6) of the EP&A Act, whether that be response to submissions, a preferred project report, or any revised statement of commitments.

- Within the 200m wide Study Area there is flexibility for the 30m right of way (ROW) to avoid direct impacts on most known issues.
- In addition to meeting regulatory requirements and guidelines, in designing the proposal the proponent has drawn on the Code of Environmental Practice developed by the Australian Pipeline Industry Association (APIA) which provides comprehensive guidance on the best techniques and methods presently available to mitigate or eliminate the environmental impact of onshore pipeline activities. The APIA Code of Practice is formally recognised in *AS 2885* Part 3 Section 7.9 which says:

  "The operating authority shall establish an approved environmental management system in accordance with regulatory requirements.
  Note: The Australian Pipeline Industry Association (APIA) Code of Practice on environmental management should be referred to by the operating authority for guidelines on environmental management of pipeline."

- Sound environmental management of the proposal would be assured through the draft statement of commitments set out in Chapter 19, and the regime for adaptive environmental management described in Chapter 18.

1.4 Environmental assessment overview

The proponent is required to prepare an EA in accordance with environmental assessment requirements issued by the Director-General of the DoP on 3 March 2008, identifying the following key issues for consideration and assessment:

- Ecological impacts.
- Heritage impacts (Aboriginal heritage).
- Human amenity impacts (relating to noise and vibration, air quality and traffic).
- Socio-economic implications.
- Land use planning impacts.
- Hazards and risk impacts.
- Surface and groundwater impacts.
- Infrastructure impacts.

A copy of the DGRs and a checklist of the requirements with cross reference to the relevant chapters of the EA is provided in Appendix A.

The primary aim of the EA is to demonstrate that the proposal can be implemented based on an understanding of the likely environmental impacts, and proposed management approaches to addressing identified adverse impacts.

To accomplish this aim, the EA utilises the following three assessment approaches to ensure adequate consideration of the likely environmental impacts:

- **Environmental risk analysis** – The purpose of this review is to identify and rank environmental issues for consideration. The review of environmental issues would identify the two categories of environmental issues, key issues and other issues. The review is based on information available to date, including previous studies, consultation and correspondence with relevant stakeholders and desktop research.

- **Screening assessment** – Key environmental issues identified through the review of environmental issues are subject to the screening assessment. The screening of key environmental issues provides for a more focussed and efficient EA. The overriding objective of the screening assessment process is to utilise a standardised and consistent approach in evaluating potential impacts for a given issue, along the entire length of the proposal. The screening assessment identifies areas of potentially significant impacts that require further consideration and management as detailed design progresses.
- **General assessment** – The issues identified as other environmental issues would undergo a general assessment of impacts. The objective of the general assessment is to focus on the development of overarching environmental management frameworks for mitigation, management and monitoring.

1.5 Structure of this report

The EA is structured in three parts.

1.5.1 Part A – Introduction

- **Chapter 1 Introduction –** Introduces the proponent and provides an overview of the proposal in general, including the proposal history and the approach the EA will take.
- **Chapter 2 Strategic context and need for the proposal –** It was necessary to consider the need for the proposal in relation to the NSW gas and energy markets, strategic infrastructure planning, policy initiatives, and from an economic perspective. This chapter addresses these key interests, highlighting the need for the new pipeline and outlining significant implications if the proposal does not proceed.
- **Chapter 3 Development of the pipeline route –** The development of the pipeline route has been a continually evolving process. Chapter 3 summarises this development and provides detail as to how the current Study Area has been achieved through a filtered approach of route options, as well as early identification and avoidance of existing environmental constraints.
- **Chapter 4 Description of the Study Area –** The pipeline route passes through a variety of environments and intersects numerous linear features. This chapter provides a brief description of the Study Area along the entire pipeline route, including the short lateral in the Maitland area, and several short alternative route options. The description includes the identification of key natural and human features.
- **Chapter 5 Proposal description –** Specific detail in regards to pipeline design and activities related to construction and operational processes is described within this chapter. This information provides an understanding of all activities that may result in potential impacts to the Study Area.
- **Chapter 6 Community and stakeholder consultation –** To further improve the route alignment, community and stakeholder consultation is a crucial process for identifying key issues that must be addressed by the proposal. This chapter details the objectives, methods, extent and outcomes of consultation undertaken during the course of developing this proposal.
- **Chapter 7 Statutory requirements –** The Commonwealth and NSW statutory requirements that are potentially relevant to the proposal are identified within this chapter. It provides a detailed account of the legislative framework within which the proposal is being assessed, including the approach taken coordinating the approval processes of both Commonwealth and NSW legislation.

1.5.2 Part B – Environmental Assessment

- **Chapter 8 Environmental assessment process –** Identifies the process the EA has taken in relation to the DGRs. It outlines the environmental risk review and provides a description of the assessment methodology for key and other issues.
- **Chapter 9 Biodiversity –** A key issue recognised in the DGRs. This chapter outlines the significance of impacts on biodiversity features in relation to the construction and operational phases of the proposal. It outlines the methodology chosen to determine relevant impacts and standard mitigation and management measures. It also highlights any areas of concern and any areas that would require further assessment.
- **Chapter 10 Heritage –** Aboriginal heritage is a key issue recognised in the DGRs. The potential impacts relating to both Aboriginal and historical heritage have been assessed in two separate technical reports (*Aboriginal Heritage Assessment* and *Historical Heritage Assessment*) that are included as Appendices E and F respectively. This chapter summarises the key issues within the two reports relating to potential impacts that may occur in both the construction and operational periods of the proposal and outlines management measures.
- **Chapter 11 Human amenity impacts –** A key issue recognised in the DGRs. This chapter provides an assessment of the potential impacts and mitigation measures relating to human amenity features associated with the proposal. It identifies adverse impacts in line with relevant regulatory requirements and industry guidelines, addressing noise, air and traffic issues.
- **Chapter 12 Socio-economic impacts –** A key issue recognised in the DGRs. This chapter addresses the socio-economic impacts of the development and operation of the QHGP. The issue of employment (both direct and indirect) associated with the construction phase and the overall economic impact of the construction activities is assessed. The economic impact of the possible flow-on activities (eg industrial, commercial and residential) is also reviewed.
- **Chapter 13 Land use –** A key issue recognised in the DGRs. This chapter addresses planning and land use with particular emphasis on potential and actual land use constraints created by the proposal. Consideration is also given to the potential for the proposal to negatively impact on agricultural production due to the significance of agricultural and rural lands through which the pipeline runs.
- **Chapter 14 Preliminary hazards and risk assessment –** A key issue recognised in the DGRs. This chapter provides a summary of the preliminary risk assessment report, which is appended to the EA (as appendix K). In accordance with the Director-General's requirements, the report includes a hazard identification and risk assessment based on *AS2885* and a quantitative risk assessment based on Hazardous Industry Planning Advisory Paper No 6.
- **Chapter 15 Surface and groundwater –** A key issue recognised in the DGRs. This chapter provides an impact assessment on potential water features that may be affected by the proposal. Potential impacts and mitigation measures have been identified for both the construction and operational phases.
- **Chapter 16 Infrastructure –** A key issue recognised in the DGRs. Infrastructure potentially impacted by the proposed pipeline includes roads, railways, electricity transmission lines and other pipelines. This chapter details relevant potential impacts in the construction and operational phases and outlines key mitigation and management measures.
- **Chapter 17 Other issues –** Assesses all other environmental issues that have not been explicitly recognised in the DGRs, but are considered relevant to the proposal. It covers waste management, geology and soils, visual amenity, greenhouse gas and climate change.

1.5.3 Part C – Conclusion

- **Chapter 18 Adaptive management of environmental constraints –** Outlines field work to be undertaken as an outcome of the screened and tiered assessment presented in Part B.
- **Chapter 19 Draft Statement of Commitments –** Outlines the proponent's commitment to the objectives and actions that must be taken for managing the environmental impacts of the proposal to minimise or avoid adverse outcomes.
- **Chapter 20 Proposal justification and conclusion** – Provides a justification for implementing the proposal.

2 Strategic context and need for the proposal

2.1 Introduction

This chapter establishes the strategic context and need for the proposal by evaluating the proposed pipeline against:

- Existing and emerging challenges within the NSW gas and energy markets.
- Economic impact including future job growth and investment.
- Strategic infrastructure planning in both the national and state context.
- Policy initiatives of the state including priorities of the *New South Wales State Plan*, the *New South Wales Greenhouse Plan* and the *State Infrastructure Strategy*.

It establishes the need for the pipeline and presents the objectives of the proposal. The implications for the NSW gas market if the QHGP does not proceed are also canvassed.

2.2 Proposal objectives

The QHGP aims to:

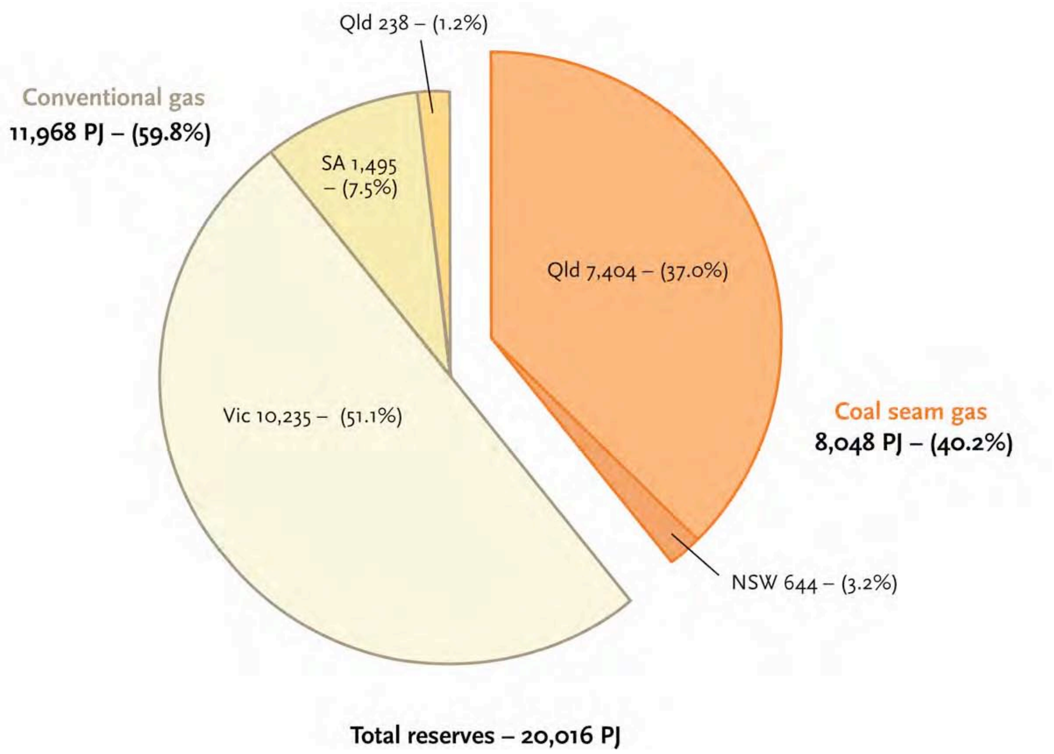
- Secure an alternative gas supply to serve the NSW gas market, particularly the economically significant Hunter and Newcastle region and north central areas of the state.
- Provide increased competition and security of supply within the NSW gas market.
- Access expanding world-class CSG reserves located within the Surat Basin in south east Queensland.
- Encourage exploration and potential development of CSG reserves in northern and central NSW.
- Facilitate the development of CSG power plants for base and/or peak load power generation along the route of the gas pipeline.
- Support economic development in regional NSW through the provision of a new gas supply and regional power generation opportunities.
- Select a pipeline route, cognisant of social, heritage, environmental, geo-technical, economic and topographical constraints that provides for the most efficient and feasible construction.
- Design and construct a pipeline that has the minimum practicable impact on both the natural and built environment.
- Utilise regional and indigenous labour in the construction and operational phases of the proposal to the fullest extent possible.
- Construct and commission the pipeline on a schedule that makes this gas available to customers as quickly as possible.

2.3 Gas supply and transmission in eastern Australia

2.3.1 Existing supply of natural gas

NSW is unique among the mainland states of Australia in not currently having a commercially viable natural gas reserve. Figure 2.1 below outlines eastern Australian gas reserves by state. Gas supplies are sourced from the Cooper Basin in South Australia and from the Gippsland Basin in Victoria. Small supplies of CSG are sourced from reserves located around Sydney, however it is expected that more significant reserves of CSG will be identified and utilised in the future particularly in north central areas of the state.

Figure 2.1 Eastern Australian gas reserves by state



Source: RLMS, February 2008

The NSW gas market has suffered in the recent past due to the limitations of gas supply and the impact of critical events on the supply network. There remain a number of risks to the security of gas supply to the NSW market that include:

- Operational risks relating to the ability to maintain sufficient supply to meet market demand, particularly in periods of peak demand evidenced by the load-shedding event in the Moomba to Sydney pipeline in June 2007. This event demonstrated that the current wholesale market arrangements are insufficient to maintain continuity of supply to natural gas customers in NSW, particularly in circumstances of high demand. The NSW Government inquiry into the event found that:
  - The event resulted from gas injections into the Moomba to Sydney pipeline failing to meet the demand for gas over an extended period commencing on 5 June 2007.
  - The level of demand was not unprecedented or excessive and should have been expected to occur during the predicted cold weather.

- A gap exists in the gas supply market arrangements that, if not addressed, may allow the events of June 2007 to reoccur.

- Strategic risks associated with an event that causes an unexpected interruption to a major supply. Such events have occurred in the past including the explosion at the Longford gas processing plant in 1998, and a fire at the Moomba Gas Plant in South Australia in 2004. Both events caused disruption to NSW's gas supply. Markets, such as NSW, which are dependent on a narrow range of resources, are more susceptible to unexpected shocks to supply caused by catastrophic events. The uncertainty surrounding the potential for shocks to supply has a material impact on business and industry.
- Longer-term risks associated with ongoing resource availability. This includes dwindling reserves and reduced production from the Cooper Basin in South Australia and the potential impact on the cost of supplying gas from this reserve given its need to supply alternate markets including Adelaide.

The proposed QHGP has the potential to address future deficiencies and ongoing security of gas supply to the NSW market. This would be achieved through access to expanding Queensland's CSG production and identified potential reserves of CSG in central and northern NSW. The diversification and increased supply has the additional benefit of potentially putting downward pressure on the cost of delivered gas to the NSW market.

2.3.2 Current east coast transmission network

The NSW gas market is principally served by two key transmission pipelines: the Moomba to Sydney Pipeline and the Eastern Gas Pipeline. Figure 2.2 outlines the existing transmission network in eastern Australia.

Figure 2.2 East coast gas transmission network and future QHGP proposal

Source: RLMS, 2008

Part A

The Moomba to Sydney pipeline supplies gas from the Cooper Basin in South Australia to NSW. The 1,300km pipeline to Wilton, approximately 50km south west of Sydney, is owned and operated by East Australian Pipeline Pty Limited. Lateral connections from this pipeline distribute gas to other markets in NSW (including Dubbo, Lithgow, Bathurst, Griffith and Wagga Wagga) and the Australian Capital Territory (ACT). The current pipeline capacity is 125PJ per annum.

The Eastern Gas Pipeline (EGP) is a 797km pipeline owned by Alinta that delivers gas from the Longford Gas Plant in Victoria to the NSW market. It runs from Longford east along the coast and then northwards passing to the east of the ACT and on to Wollongong and Sydney. The pipeline has a current capacity of up to 73PJ per annum and principally supplies Port Kembla (Bluescope Steel) and Alinta’s distribution network in NSW.

The south east of NSW is well serviced by the Victorian gas transmission pipeline system. This system runs from Melbourne to Albury, Wagga Wagga, and as far as Lithgow and Orange. This system allows gas to move either from Victoria to NSW or from NSW to Victoria depending on gas markets.

The only physical link between gas suppliers in Queensland and the southern gas markets is a 180km dual phase connection between the Moomba gas plant (Cooper Basin) in South Australia and the Ballera processing centre in south west Queensland which is used to transport gas and liquids. The capacity of this Santos controlled gas pipeline is around 50PJ per annum.

In recent history, the majority of gas delivered to markets in Queensland is transported via a 756km pipeline (the South West Queensland Pipeline – SWQP), which links the Ballera gas centre to the ML1A station near Wallumbilla (flowing west to east). More recently, this pipeline has begun to deliver gas to the west (reverse flow) and is expected to do so permanently in the near future. This is a result of declining production in the Cooper Basin coupled with growing production of CSG in south east Queensland and the continued requirement to supply gas to markets in NSW and South Australia. The SWQP is believed to have a maximum capacity of around 50PJ per annum (when configured to flow westward).

The most obvious deficiency in the current transmission network in NSW is the lack of gas supply to the north east of NSW between Newcastle and the Queensland border.

The *Report of the Owen Inquiry into Electricity Supply*, 2007 (Owen Inquiry) into energy supply in NSW found that additional pipeline capacity would be required in order to meet the forecast gas demand requirements of the State. This increase in capacity may be achieved through a combination of pipeline expansions together with new pipeline infrastructure.

The Inquiry also found that any investment decision for a new pipeline or expansion to the current pipeline network should consider the likely increase in demand for gas and the availability of future gas supply. The proposed QHGP would provide a key link in the eastern Australian gas supply system, creating additional gas supply security to Newcastle and Sydney while opening these markets to increasing proven reserves of CSG in south east Queensland and northern NSW.

2.3.3 Future supply of gas

With the forecast continued decline in Cooper Basin production, both NSW and South Australia will require alternative gas supplies to meet future demand. At the same time as the decline in reserves within the Cooper Basin is occurring, proven CSG reserves in southern Queensland have grown from less than 500PJ to around 4,000PJ. CSG is now accepted in the energy industry as a reliable source of gas supply, typified recently by Rio Tinto Aluminium’s contract with Origin Energy for 20PJ per annum over 20 years to supply the expansion of the Gladstone Alumina refinery.

Background studies by Wood Mackenzie (Owen Inquiry into Electricity Supply in NSW: Availability and Cost of Gas for NSW Base load Generation, July 2007) undertaken as part of the Owen Inquiry have forecast that CSG production potential is such that by the end of next decade CSG could account for more than 50 per cent of the total gas supply in eastern Australia.

North eastern NSW contains significant sedimentary sequences, which are expected to have considerable potential natural gas reserves, both conventional and CSG. Potential reserves have been identified as follows:

- Surat Basin, in the north of NSW.
- Clarence – Moreton Basin, to the east of the New England Tableland.
- Gunnedah Basin, around Narrabri, Coonabarabran and Gunnedah.
- Sydney Basin, in the Hunter region.
- Gloucester Basin, north of Newcastle and east of the Great Dividing Range.

The QHGP would offer transmission to key industrial and commercial centres creating increased potential for the exploration and commercial operation of a number of these reserves.

The Owen Inquiry has identified that gas is currently available at around $4 per GJ in the eastern Australian market. However, there is a significant degree of uncertainty around gas prices. The Owen Inquiry further identified a range of potential forecast delivered gas prices. These ranged from a modest increase with no new gas-fired energy generation, to an increase in price to $6.50 per GJ with new gas-fired base load electricity generation.

With an initial throughput capacity of approximately 80PJ per annum, potentially rising to around 160PJ per annum, the proposed QHGP has the potential to augment gas supply to the NSW market providing greater certainty for industry and electricity generators while improving price competition for delivered gas.

2.4 Current and expected energy and gas demand

2.4.1 Current demand for gas

The eastern Australia gas market has been historically characterised by discrete demand regions connected to individual sources by a direct transmission pipeline. The gas market has become increasingly interconnected, through the construction of additional gas delivery infrastructure such as the EGP. Therefore, the availability of gas supply to meet the requirements of potential future gas-fired base load generation in NSW must be assessed in the context of the total eastern Australian gas demand and supply.

The total number of gas delivery points in the NSW and ACT retail gas markets grew to almost 1.2 million in 2006/07, with an additional 30,325 new delivery points being created (Gas Market Company: Market Report 2007).

The eastern Australia market benefits from sufficient gas supply to mostly meet domestic consumption, however, it has not supported an export industry. The market is therefore self contained, and not subject to international competition. This has resulted in eastern Australia historically having gas prices that are significantly lower than the international gas price. However, as demand increases prices are expected to rise. Proposals such as the various liquefied natural gas (LNG) export terminals in Gladstone in Queensland will open the eastern Australia market to an export market, and have the potential to add further inflationary pressure to the price of delivered gas in the NSW market.

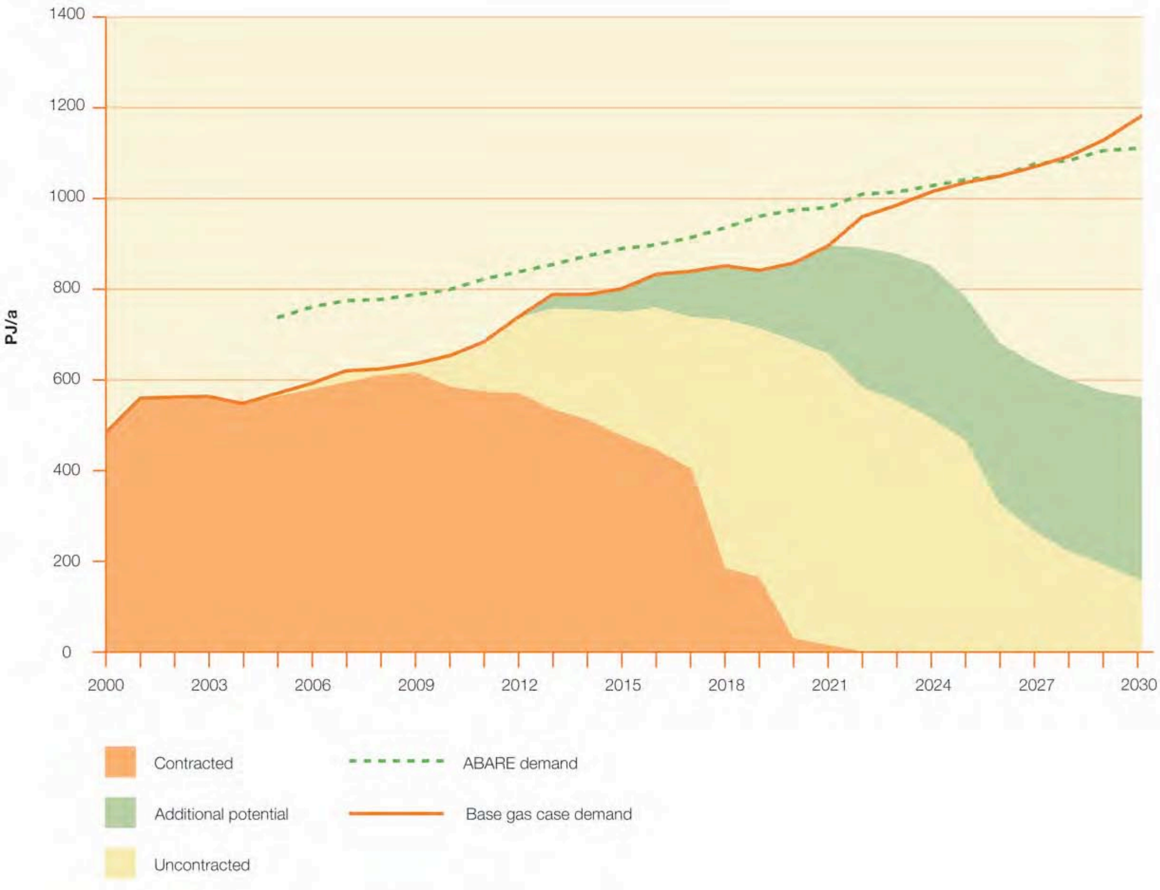
Wood MacKenzie (Owen Inquiry into Electricity Supply in NSW: Availability and Cost of Gas for NSW Base load Generation, July 2007) undertook a series of demand modelling scenarios for the Owen Inquiry. This analysis looked at the implications for gas demand in NSW flowing from the scenarios of increased gas-fired generation in the State. The consideration of these demand scenarios in relation to the QHGP is important given proposals to expand existing generation in the Hunter region and proposals to develop new generation such as Macquarie Generation's proposed gas-fired power plant at Tomago which in initial phases is expected to generate 500MW with an ultimate capacity of up to 800MW. The scenarios modelled by Wood MacKenzie included:

- A business as usual case.
- 1,000MW of additional gas-fired base load power generation in NSW.
- 2,000MW of additional gas-fired base load power generation in NSW.
- 2,500MW of additional gas-fired base load power generation in the national energy market.

Assuming the implementation of the high demand case, scenario four, whereby all new generation coming on stream in NSW and Victoria is gas-fired, then gas demand in NSW is expected to grow to around 250PJ per annum by 2015, reaching around 350PJ by 2030. Under these scenarios a 500MW combined cycle gas turbine power plant, such as that proposed at Tomago, would generate gas demand at a 75 per cent load factor of approximately 15PJ per annum as per the Owen Inquiry.

Figure 2.3 details eastern Australian gas demand and supply assuming the base business as usual case.

Figure 2.3 Eastern Australia base gas case[1] supply/demand 2000–2030



Source: Wood Mackenzie, July 2007, p 6

1. The business as usual base case used by Wood MacKenzie represents a low gas demand case as all the base load capacity installed for the period 2013 to 2016 in NSW and Victoria under this scenario are coal fired generators (consistent with the NEMMCO 2006 SOO table H8) and includes the existing gas-fired generation in NSW (including co-generation facilities and coal mine gas generators) plus committed gas-fired generation – Tallawarra CCGT (under construction).

The difference in initial gas demand in 2006 between Wood Mackenzie and ABARE are a result of different gas demand methodologies:

- *Wood Mackenzie's gas demand represents the sale of gas at the point of injection of each supply point (ie. Ex-plant, after fuel and production losses).*
- *ABARE's gas demand represents the total gas production (ie well head production, before fuel and production losses) and including ethane.*

2.4.2 Increased demand for electricity generation

The Owen Inquiry identified that NSW currently uses more electrical energy (79,030GWh in 2005–6) than any other state, with consumption growing by about 1,700GWh per year for around the past 30 years. TransGrid forecasts reviewed as part of the Owen Inquiry anticipate a slightly slower average growth rate of around 1,600GWh per year over the next ten years, in part due to the impact of demand management and energy efficiency measures being implemented as part of broader government initiatives and policy.

The Owen Inquiry found that forecast growth in electricity use implies a need to provide around 91,000GWh of electrical energy in NSW by 2013–14. This is around 10,500GWh above current annual consumption.

NSW has traditionally had access to surplus generation capacity (including electricity imports from interstate) for the last 15 years, which has been more than sufficient to meet the growth in energy consumption. However, this surplus has reduced significantly as energy consumption has continued to grow at a faster rate than generation capacity.

The Owen Inquiry found that it is likely that new generation capacity will be required in the State within the period 2013–17.

The NSW Government has recently announced that it will be moving to partially privatise electricity retail businesses in the State, and will be moving to lease generation and transmission networks with a view to ensuring that new investment can be made in the electricity generation industry. The form of this investment is most likely to be the expansion of new generation capacity either through upgrades to existing generation assets or via a new base load power station.

The impact of such expansion on the NSW gas markets should not be understated. In an increasingly carbon constrained environment, the benefits associated with the efficiencies of gas-fired peaking and base load power plants become more apparent when considering the expected future pricing of carbon on a national exchange.

The Owen Inquiry found that current delivered gas prices equate to around $25 per MWh of electricity generated. Whilst this is more expensive on a per MWh basis than coal (at around $10/MWh), the much higher capital cost of coal plants means that gas-fired generators have a lower total average cost than coal-fired generators at lower utilisation rates. When potential future carbon prices are factored into the cost of electricity generation, it is expected that gas-fired generation will become increasingly competitive to that of coal-fired generation.

2.4.3 Increased demand for gas

The Owen Inquiry identified that the significant probable gas demand area in the state is within the Newcastle and adjacent Hunter region where industries including aluminium smelting and electricity generation are located. Existing gas demand in the lower Hunter/Newcastle region is approximately 25PJ per year. This demand is expected to increase with access to competitively priced delivered gas and the increased costs associated with environmental and greenhouse compliance especially in electricity generation.

Probable future gas demand in northern and central NSW may also be driven by new or embedded power generation, which would benefit from gas supplied from the proposed pipeline.

Under the generation scenarios provided by the Owen Inquiry secretariat, the potential to increase the level of base load gas-fired generation in the State up to 2016 is substantial. The required gas supply to meet this forecast demand would be predominantly from Victoria and Queensland, and would require expansion of existing gas transmission networks and investment in new pipelines to access additional reserves. Accordingly, the Owen Inquiry found that an important issue for CSG in NSW is access to pipeline infrastructure with the opportunity for new pipelines from Queensland to follow routes, which can serve CSG operations in NSW (Owen Inquiry, 2007, p.3–26). There is significant upside potential for CSG reserves in NSW in the medium term. If these were developed, the relative price differential between Queensland and NSW could change dramatically over the next few years.

2.5 Economic benefit

The projected economic benefits of the QHGP to NSW are significant. They have two key elements:

- Direct benefits associated with the construction and operation of the pipeline and supply of gas.
- Future potential benefits associated with the proposal.

The overall investment in the pipeline proposal is approximately $860 million. This will result in around $560 million of direct investment into NSW. The pipeline proposal is expected to create up to 600 jobs during construction and 25 direct permanent jobs during operation. The proposal is expected to make a much greater contribution to the State's economy via the expansion of industry and job creation throughout regions which the pipeline supplies, particularly the Hunter region and Newcastle. This is expected to occur through additional investment in existing and emerging industry and electricity generation.

The Owen Inquiry has identified that additional pipeline capacity would be required to meet the forecast gas demand requirements of NSW and that the proposed QHGP would provide a key link in the eastern Australian gas supply network. Equally important is the size and quality of CSG reserves in Queensland which, once accessed, will have a positive impact on both delivered gas cost and supply availability for NSW users including industry and electricity generators.

Analysis by ANZ Infrastructure Services (ANZIS – *Queensland Hunter Gas Pipeline proposal benefits, ANZ Infrastructure Services* – see Part C, References) has indicated that potential economic benefits to the Hunter would be driven by expansion of industries including aluminium smelting and the retention and attraction of energy intensive industries within areas such as the HEZ and Macquarie Buffer Zone. ANZIS estimate that the expansion of the aluminium smelting industry could result in a capital investment of approximately $1 billion.

By virtue of the size, reliability, and route of the pipeline a number of the projects mentioned above are likely to be implemented and expanded in line with increased access to better-value gas. Macquarie Generation's proposed 800MW gas-fired power station within the Tomago Industrial Estate, when commissioned, will also result in a significant direct investment into the regional economy.

Future benefits to the NSW economy include the potential for development of significant potential CSG reserves in the north of the State along the pipeline's proposed route. The prospect of accelerating access to, and development of, these reserves would increase significantly with access to a major transmission pipeline connecting to significant markets. ANZIS has estimated that development of these reserves to supply 20PJ of gas per annum is likely to benefit the economy by up to $100 million. Additional gas production has the potential to increase royalty revenue for the State, estimated at $15 million based on the present value of future royalties over ten years.

ANZIS noted that the proposed project would bring a total direct and associated investment of approximately $2.4 billion to NSW. Secondary benefits associated with the proposal have not been evaluated. However, these benefits could be expected to have economic multiplier effects of up to three times in urban areas and seven times in rural areas.

There is also the potential for sharing the proposed pipeline alignment with third party infrastructure, as long as that infrastructure would not influence the integrity of the pipeline's safety and operation. An example of compatible infrastructure sharing could be underground telecommunications networks.

2.6 Government policy objectives

2.6.1 The NSW State Plan

The NSW State Plan establishes the government's strategic approach to identified challenges and opportunities of the future. The plan sets out clear priorities for government action, with targets for improvement designed to guide decision-making and resource allocation. In addition, the NSW State Plan sets out how the government will work to deliver on these priorities. The State Plan is set out in terms of five areas of activity:

- Rights, respect and responsibility – encompassing the justice system and services that promote community involvement and citizenship.
- Delivering better services – the key areas of service delivery to the whole population including health care, education and transport.
- Fairness and opportunity – the delivery of services that promote social justice and reduce disadvantage.
- Growing prosperity across NSW – activities that promote productivity and economic growth with particular priorities for the economic development in rural and regional communities.
- Environment for living – encompassing planning, environmental protection and the arts and recreation.

Specific priorities of the State Plan that the QHGP will contribute towards with no government expenditure include:

- P1 – Increased business investment with the government committing to cutting red tape, maintaining and investing in infrastructure and increasing participation in education and training. A particular focus is on continuing to deliver jobs growth through aggressive targeting of investment and innovation. The government is also committed to strengthening regional development including the promotion of innovation in the energy, and related resources sector. The New South Wales Innovation Statement also emphasises the need for government to focus on industries that will have the greatest benefit to NSW with the resources sector, and related energy sector, again being identified as key priority areas.
- P2 – Maintain and invest in infrastructure to support economic growth with the government committing to an average annual capital expenditure growth rate of 4.6 per cent. The government is also committed to encouraging regional development through improved infrastructure provision. This priority is underpinned by the State Infrastructure Strategy, which identifies capital expenditure of $41 billion over the next ten years focused on investment by the private sector in the electricity and energy sectors.

- P6 – Increased business investment in rural and regional NSW with a focus on boosting regional economies by building on existing regional industries that hold competitive advantages and the development of new industries.
- E3 – Cleaner air and progress on greenhouse gas reductions with the *New South Wales Greenhouse Plan* committing the government to targets that aim to achieve a 60 per cent reduction in greenhouse emissions by 2050 and a reduction to year 2000 greenhouse emissions levels by 2025.

2.6.2 The NSW Greenhouse Plan 2005

The NSW Greenhouse Plan commits the NSW Government to greenhouse gas emissions targets of:

- A 60 per cent cut in greenhouse emissions by 2050.
- Reducing greenhouse emissions to year 2000 levels by 2025.

NSW is currently responsible for just over a quarter of Australia's total greenhouse gas emissions. Per capita emissions in NSW are approximately 23 tonnes per year, which is significantly higher than comparable countries such as the United Kingdom, Germany and Japan. These countries have per capita emissions of approximately ten tonnes, with the average for industrialised nations being around 13 tonnes per capita.

NSW's relatively high per capita emissions are due principally to the relative abundance of cheap fossil fuels and high dependence on coal-fired power generation. Approximately 91 per cent of NSW electricity supply comes from coal-fired generation with six per cent coming from hydro generation. Only around three per cent of emissions result from gas-fired generation. Around 47 per cent of all greenhouse emissions in NSW result from energy generation.

Nationally, emissions from energy generation are expected to grow to 41 per cent higher than 1990 levels by 2010. Outside of energy generation, the sectors using the most energy are manufacturing (42 per cent), residential (23 per cent), commercial (18 per cent) and mining (14 per cent).

The NSW Government has committed to diversifying the State's energy generation mix by investing in renewable generation and by increasingly meeting peak demand through gas-fired generation. These investments include:

- New gas-fired peaking stations at Tomago in the Hunter Valley and Uranquinty near Wagga Wagga.
- Planning approval for a further three gas-fired power stations at Munmorah, Bamberang and Marulan.

Gas-fired power stations produce on average less than half the carbon emissions of new coal-fired power stations and therefore are likely to benefit relative to coal-fired generation when a national emissions trading scheme is introduced. Provided a high enough carbon price is implemented, gas-fired turbines may have the potential to provide lower cost base load power than coal-fired generation.

A national emissions trading scheme is likely to be implemented more swiftly given the Australian Government's ratification of the Kyoto Protocol. It is expected that a national emissions trading scheme, and the pricing of carbon within the scheme, will influence the technology that generators employ in embedded and new generation capacity. This is likely to result in an increase in renewables and gas-fired generation.

The Owen Inquiry has identified that, provided the proposed QHGP proceeds, there is likely to be sufficient gas supply to support up to 400MW of gas-fired base load generation in the Hunter region (p.3–26).

2.6.3 NSW State Infrastructure Strategy

The NSW State Infrastructure Strategy commits the government to record capital expenditure on maintenance and new infrastructure and links the Sydney Metropolitan Strategy and other regional planning strategies including the Lower Hunter Regional Strategy with the budget. The strategy specifically delivers on identified infrastructure commitments across the health, education, transport and energy sectors.

The State Infrastructure Strategy commits to investment of $41.3 billion in infrastructure over the next four years with investment over the next decade expected to reach around $110 billion. Approximately 10–15 per cent of this investment is expected to be financed by the private sector.

The strategy identifies that a reliable and competitive electricity sector is essential to ensure that NSW remains economically competitive and to drive economic growth. The State Infrastructure Strategy encourages private sector investment in new generation. The strategy particularly focuses on the need to deliver a new base load generation plant in advance of projected base load shortfalls in the coming decade. Extra base load capacity will be necessary in the medium term as average demand levels continue to rise.

The strategy also notes that emissions trading schemes for greenhouse gases are likely to become more widespread, with targets that are more robust and costly to achieve. The impacts are likely to be felt in the transport and electricity sectors.

The strategic importance of the QHGP to the state is highlighted by the declaration of the proposal by the Minister for Planning as critical infrastructure (Department of Planning: NSW Major Development Monitor 2006/07). The pipeline will also have positive benefits for future investment in the state's electricity generation network by providing a reliable and affordable supply of gas. This is particularly so for Macquarie Generation's proposed 800MW gas-fired power plant at Tomago along the route of the pipeline.

Part A

2.6.4 Lower Hunter Regional Strategy

The Lower Hunter Regional Strategy provides the government's strategic planning framework for accommodating expected regional growth over the next 25 years. The strategy identifies that the region is expected to see employment growth of approximately 66,000 new jobs and population growth of 160,000.

The strategy aims to promote and harness the lower Hunter's competitive advantages to maximise opportunities for economic growth including expansion of traditional manufacturing, the significant port, the teaching hospital and educational facilities.

The strategy identifies that the economic challenges for the region are to:

- Maximise the economic opportunities associated with the region's competitive advantages, in particular its economic infrastructure and specialised centres.
- Ensure sufficient employment opportunities are available in appropriate locations, including within centres and as traditional industrial land, to provide sufficient capacity to accommodate growth in existing and emerging industries and businesses.
- Maintain or improve the employment self-sufficiency of the region.
- Ensure activity within the lower Hunter complements rather than competes with the economies and communities of adjoining regions.

The proposed QHGP will contribute to a number of these aims by supplying a secure and affordable energy supply to regional industry particularly traditional manufacturing industries and the electricity generation industry.

2.7 Need for the proposal

The proposed QHGP will provide a vital missing link in the eastern Australian gas transmission network. It will serve to connect the NSW gas market to world-class reserves of CSG in south east Queensland providing additional diversity of supply to that already sourced from the Gippsland and Cooper Basins.

Establishing the need for the proposed pipeline is based on a combination of factors including:

- Safeguarding the supply of gas to the NSW market.
- Providing competition within the NSW gas market.
- Delivering infrastructure to boost regional economic growth.
- Providing a supply of energy that has the potential to contribute to reductions in greenhouse gas emissions.

2.7.1 Safeguarding gas supply

The proposed QHGP will diversify gas supply to the NSW market reducing the impact of operational, strategic and long-term risks to the gas market posed by the current dependence on the Moomba to Sydney gas pipeline and EGP.

The specific risks to the NSW gas market resulting from dependency on few sources of interstate gas include:

- Vulnerabilities associated with dwindling reserves in the Cooper Basin, which is expected to see reduced production within the next decade.
- The potential for the loss of supply caused by a catastrophic event to one of the two existing pipelines or the gas plants that supply them.

The Owen Inquiry into electricity supply in NSW has also identified the proposed QHGP as a key missing link in the eastern Australian gas supply network connecting the NSW market with the significant CSG reserves in south east Queensland. The pipeline also has the potential to generate further exploration and development of probable significant reserves in northern and central areas of NSW.

2.7.2 Providing a competitive gas market

NSW does not currently have large commercially viable gas reserves and as such is required to import gas to supply the market from interstate. Accordingly, the NSW market is reliant on supply from the Cooper Basin in South Australia and offshore reserves in Gippsland, Victoria.

Despite the narrow diversification of gas supply, delivered gas prices in NSW have remained relatively immune to significant price rises. This has been due to the significant production capacity in the Cooper Basin and Gippsland and the fact that there is little or no export of gas from the east coast of Australia. This means that the price of gas in eastern Australia has not attracted an export premium.

With the expected decline in production in the Cooper Basin, the potential for shortage of gas supply could have a number of impacts on the NSW gas market, the most significant impact being increased gas costs. The QHGP would increase security of supply for some areas of NSW, reducing the chances of a significant service interruption and provide competition in the market, which has the potential to maintain or reduce current gas prices.

The Owen Inquiry has identified that additional pipeline capacity will be required to meet the forecast gas demand requirements of NSW. The proposed QHGP would provide a key link in the eastern Australian gas supply network linking NSW to significant, world-class CSG reserves in Queensland. Once accessed, it is expected that additional gas supplied from Queensland will have a positive impact on both delivered gas cost and long-term supply availability for NSW users, particularly industry and electricity generators.

2.7.3 Boost regional economic growth

The overall investment in the pipeline proposal is about $869 million. This will result in around $560 million of direct investment into NSW. The pipeline is expected to create up to 600 jobs during construction and 25 direct permanent jobs during operation.

The Lower Hunter Regional Strategy has identified that the region is expected to have population growth of up to 160,000 new residents and around 66,000 new jobs over the next 25 years with a significant proportion of these jobs to be provided within traditional industries including electricity generation, manufacturing and aluminium smelting. Investment in expansion of these industries is expected to be influenced by the availability of infrastructure and cost effective and secure energy supply.

2.7.4 Greenhouse benefits

NSW's relatively high per capita greenhouse gas emissions are primarily due to the State's high dependence on coal-fired power generation. As previously stated around 47 per cent of all greenhouse emissions in NSW result from electricity generation and around 91 per cent of NSW electricity supply currently comes from coal-fired generation.

Gas-fired power stations produce on average less than half the carbon emissions of new coal-fired power stations. The QHGP, combined with the potential of increased costs associated with environmental and greenhouse compliance, has the potential to positively influence investment in gas-fired generation technology through access to competitively priced delivered gas.

A secure and affordable supply of gas would also benefit projects such as Macquarie Energy's proposed 800MW gas-fired power plant at Tomago particularly in the event of the introduction of a national carbon emissions trading scheme. Reductions in greenhouse gas emissions resulting from such a plant using gas-fired generation as opposed to coal-fired generation would be significant. Greenhouse gas emission reductions such as this would make a material contribution to the NSW Government's greenhouse gas emission reduction targets outlined in the Greenhouse Plan.

Section 17.5 presents a review of greenhouse gas as part of the potential impacts assessment.

2.8 Consequences of the proposal not proceeding

There are a number of significant consequences for the NSW economy should the proposal not proceed. They include:

- The potential for adverse impact on the NSW economy of significant power service interruptions resulting from a catastrophic failure of the existing gas transmission network. This could include loss of income, decreased productivity and higher maintenance costs. The eastern Australian gas market has suffered from two such events in the last decade resulting in significant economic impact.
- The potential for service interruptions to commercial customers as higher priority customers such as residences and hospitals are connected. This has occurred during very cold weather events in the past and is likely to increasingly happen as present supplies dwindle and more customers are added. This will particularly affect the Newcastle and Hunter areas.

- The risk to long-term supply of the NSW gas market posed by dwindling reserves in the Cooper Basin in South Australia, particularly the impact of increased delivered gas prices on the NSW economy resulting from narrow diversification of supply and increases in demand for gas.
- The loss of economic growth, including temporary and permanent employment that would be generated by the construction and operation of the pipeline.
- The loss of economic benefit derived from private sector investment in electricity generation and industry resulting from a lack of a secure and affordable supply of gas to the Hunter and Newcastle regions.
- The loss of potential economic benefit that may be derived from the further exploration and commercial production of CSG reserves in the north of the State.
- Reduced potential for further investment in gas-fired peaking and base load power generation to meet predicted increases in demand for electricity by 2013/14.

3 Development of the pipeline route

Development of the Study Area has evolved over a number of years. This chapter provides a summary of the general route development to achieve the Study Area which is the subject of this assessment. This chapter documents and describes the broad, high-level objectives and criteria that were used to guide the development and identification of general route options from Wallumbilla to Newcastle that avoided key constraints. The Study Area was further refined through an iterative process, including ongoing consultation with stakeholders and landowners and a review of the EA criteria, to avoid additional identified constraints. The process for ongoing refinement of the Study Area is also described in this chapter.

3.1 Objectives for pipeline route selection

The objectives for the QHGP proposal are presented in Section 2.2. The objectives were translated into objectives for the pipeline route selection as follows:

- Supply CSG to Newcastle and strategic locations in northern NSW.
- Take into account potential CSG developments in northern NSW.
- Service potential markets in the Newcastle and the Hunter Valley area.
- Achieve an economically and environmentally feasible route for construction.
- Provide an operable pipeline taking into consideration environmental, access, stakeholder and cost impacts.
- Satisfy principles of ecologically sustainable development (ESD).

3.2 Methodology

The development of the pipeline general route options was based on a process that was undertaken over a number of years. The methodology took into account the objectives set out in Section 3.1 and the need to maintain flexibility in design to account for identified environmental issues and/or constraints. Underpinning the methodology for route selection were principles of ESD, in particular a fundamental consideration was conservation of biological diversity and ecological integrity. A precautionary approach was taken to avoid risks of serious or irreversible environmental damage, and to maintain the health diversity and productivity of the environment for future generations. These principles are reflected in the design philosophy of avoiding areas of high biodiversity and cultural heritage value, and a preference for running the pipeline through already disturbed areas.

The methodology used to arrive at the Study Area was based on a filtered approach, the objectives of which were to:

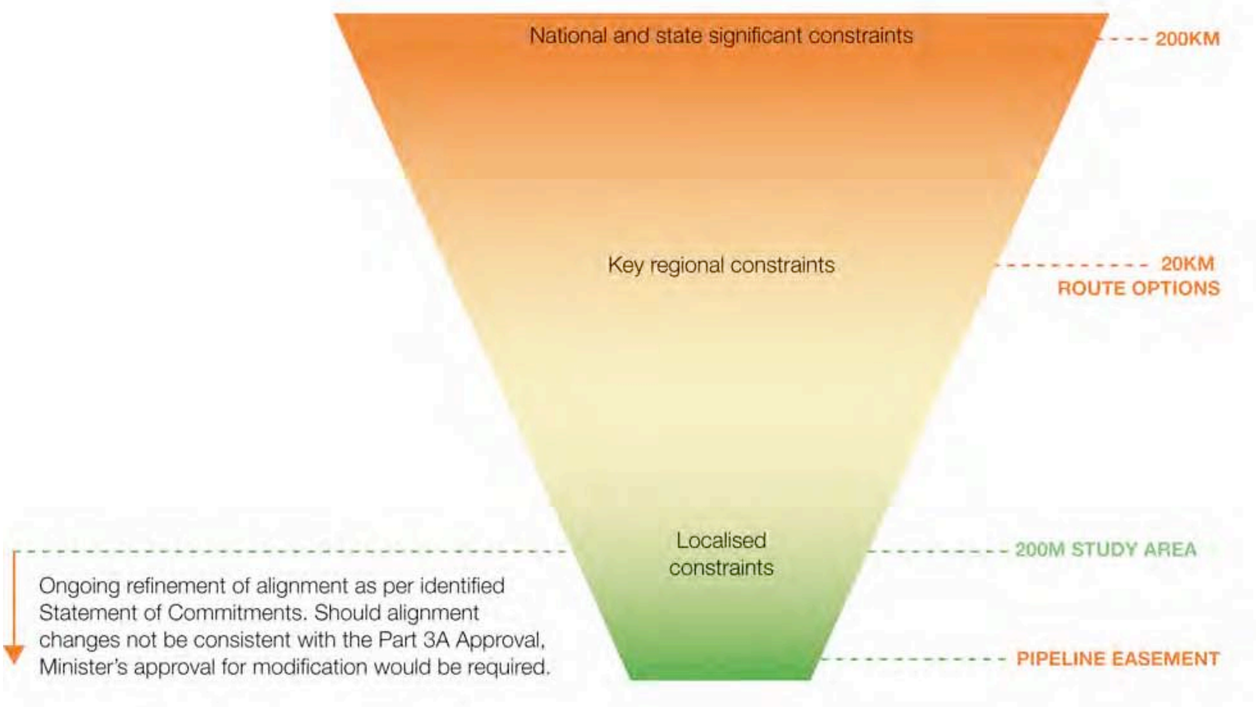
- Broadly investigate the environment between Wallumbilla and Newcastle, an area of 200km in width (refer to Figure 3.2).
- Identify key constraints to the selection of a commercially viable pipeline route (refer to Figure 3.3).
- Investigate and comparatively assess alternative general route alignments, each 20km wide, to achieve the most direct route with the fewest constraints for construction and operation.
- Recommend the optimal route option, 200m wide (Study Area) within the selected general route alignment that would be taken forward for further assessment (refer to Figure 3.4).

The sections below detail the results of the route selection process.

The 200m Study Area has been further refined through an iterative process of ongoing consultation with stakeholders and landowners and findings during the course of the assessment. This has resulted in the avoidance of additional identified constraints (refer to Section 3.6).

The overall process of development and refinement of the pipeline route is outlined in Figure 3.1.

Figure 3.1 Route refinement process

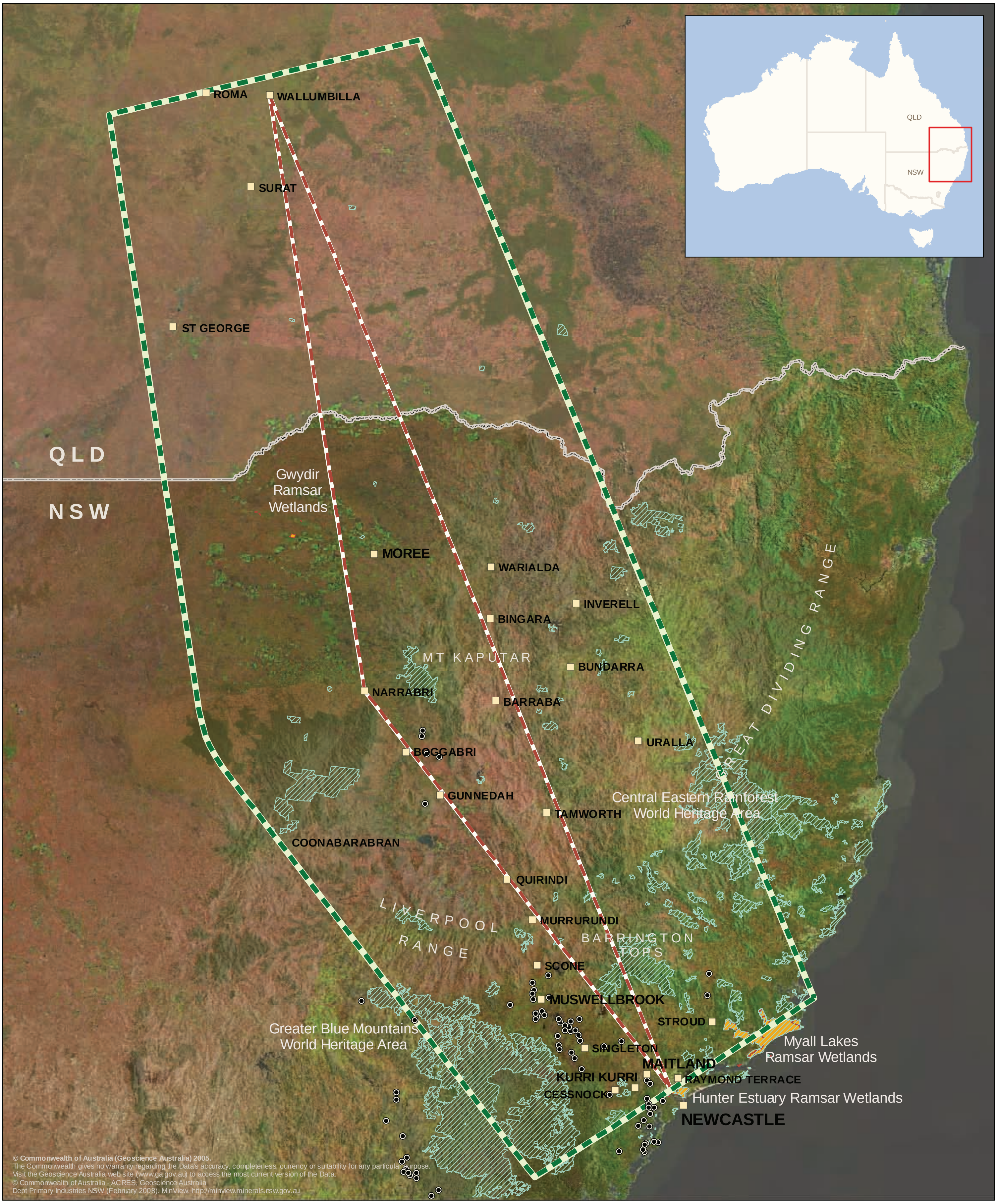


3.3 Regional constraints analysis

Regional constraints within the 200km starting corridor, including National Parks, topographic and ecological constraints, were identified, based on a desktop review. The regional constraints associated with the starting corridor are summarised in Table 3.1 and shown in Figure 3.2.

Table 3.1 Summary of key regional constraints

Constraint	Location	Recommended objectives for route selection
Major topographical constraints:		Avoid highly constrained topography (eg high elevation or steep terrain):
• Mount Kaputar.	• East of Narrabri.	• Avoid by staying east or west.
• Barrington Tops.	• East of Scone.	• Avoid by staying east or west.
• Liverpool Range.	• East to west near Murrurundi.	• Affects a large area – aim to achieve easiest route/lowest cost across range.
• Great Dividing Range.	• North to south, in the south east of the region.	• Avoid, if possible.
RAMSAR wetlands:		Avoid wetlands:
• Gwydir.	• West of Moree.	• Avoid wetland and area immediately upstream.
• Hunter Estuary.	• Mouth of Hunter River (includes Kooragang Nature Reserve).	• Avoid wetland and area immediately upstream.
• Myall Lakes.	• On coast, east of Stroud.	• Avoid by staying west of coastal areas.
Land use.	Southern Queensland and northern NSW. Many pockets throughout all potential routes.	• Minimise land use conflicts with good quality agricultural land and cropping areas. • Minimise impacts to laser levelled fields by use of existing easements or fences. • Avoid Travelling Stock Reserves (TSRs).
Coal mining areas (potential subsidence areas).	Concentrated between Muswellbrook and Singleton. Other mines to the east of Boggabri, south east of Gunnedah and north of Stroud.	Avoid active mining areas and areas subject to subsidence.
World Heritage properties:		Avoid all World Heritage properties:
• Central Eastern Rainforest.	• South eastern section of the region, comprising numerous national parks and reserves.	• Avoid by staying east or west of Barrington Tops and Mt Royal National Parks. Keep west of Oxley Wild Rivers National Park, Werrikimbe National Park and Mt Seaview Nature Reserve.
• Greater Blue Mountains.	• In the south western section of the region.	• Avoid by staying to the north.
Protected areas.	Concentrated in the south of the region.	• Avoid all protected areas.



Drawing no. 07002g_CP_18

Date 08 May 2008

Source Geoscience Australia
NSW Dept Environment & Climate Change
NSW Dept Primary Industries
RLMS Pty Ltd

Datum GDA 94

Legend

- 200km study area
- Direct line options
- National Park
- Ramsar sites
- Populated place
- Coal mine

Queensland Hunter Gas Pipeline

Figure 3.2 Overview of regional contraints within 200km corridor

0 25 50 75 100km

3.4 General route selection

3.4.1 General route selection criteria

Within the broad region selected, various general route options were considered taking into account the key constraints identified in Table 3.1 and the route selection criteria set out in Table 3.2. Selected general routes were around 20km wide, linking key potential gas demand and supply areas, whilst taking into account major natural and cultural features of the region.

Table 3.2 General route selection criteria

Criteria	Rationale
Directness of route from source to market.	Shorter routes may offer significant economic, environmental, social and logistical benefits.
Location of existing linear routes suitable for pipeline construction.	Utilisation of existing linear routes (eg roads or powerlines) that may avoid or reduce impact to sensitive areas. Constraints exist in utilising routes occupied by other infrastructure such as electrical interference which may affect safety and corrosion potential. TSRs may contain remnant vegetation.
Major terrain constraints.	Unduly steep or rugged mountain ranges, extensive areas of rock, large number of major river crossings, etc each tend to increase the difficulty and cost of construction and influence the scale of potential environmental impact.
Areas of conservation significance.	Minor deviations may avoid impact on regional ecosystems.
Location of regional gas markets.	Additional markets make the proposal economically more attractive.
Location of potential gas resources.	Additional gas suppliers/resources make the proposal economically more attractive.
Pipeline constructability.	The location needs to consider all construction aspects and impacts.
Pipeline operability.	The location needs to provide for low impact and safe access for routine maintenance and integrity monitoring.
Pipeline security.	Ideally the pipeline is located on private property where public access is limited. The pipeline is ideally suited to rural land uses, particularly grazing and areas unlikely to be targeted for high density uses.
Impacts on mining, agricultural, urban and infrastructure areas.	Location of the pipeline taking into account current and future mining expansion and potential conflicts with other existing infrastructure (eg roads, rail lines, powerlines) and agricultural uses and residential areas.

Source: Route options – RLMS, 2004

3.4.2 Description of general routes

Based on the regional constraints analysis, the development of general route options was primarily constrained in the north by the RAMSAR wetlands west of Moree, Mount Kaputar east of Narrabri and the irrigated cotton and other agricultural districts from the Queensland border south to Narrabri. The large area over which irrigated farming occurs makes this an unavoidable but manageable constraint. The Gwydir RAMSAR wetlands can be easily avoided.

The primary constraints in the south and south east were the collieries and associated mine subsidence areas, World Heritage areas, RAMSAR wetlands and mountainous terrain.

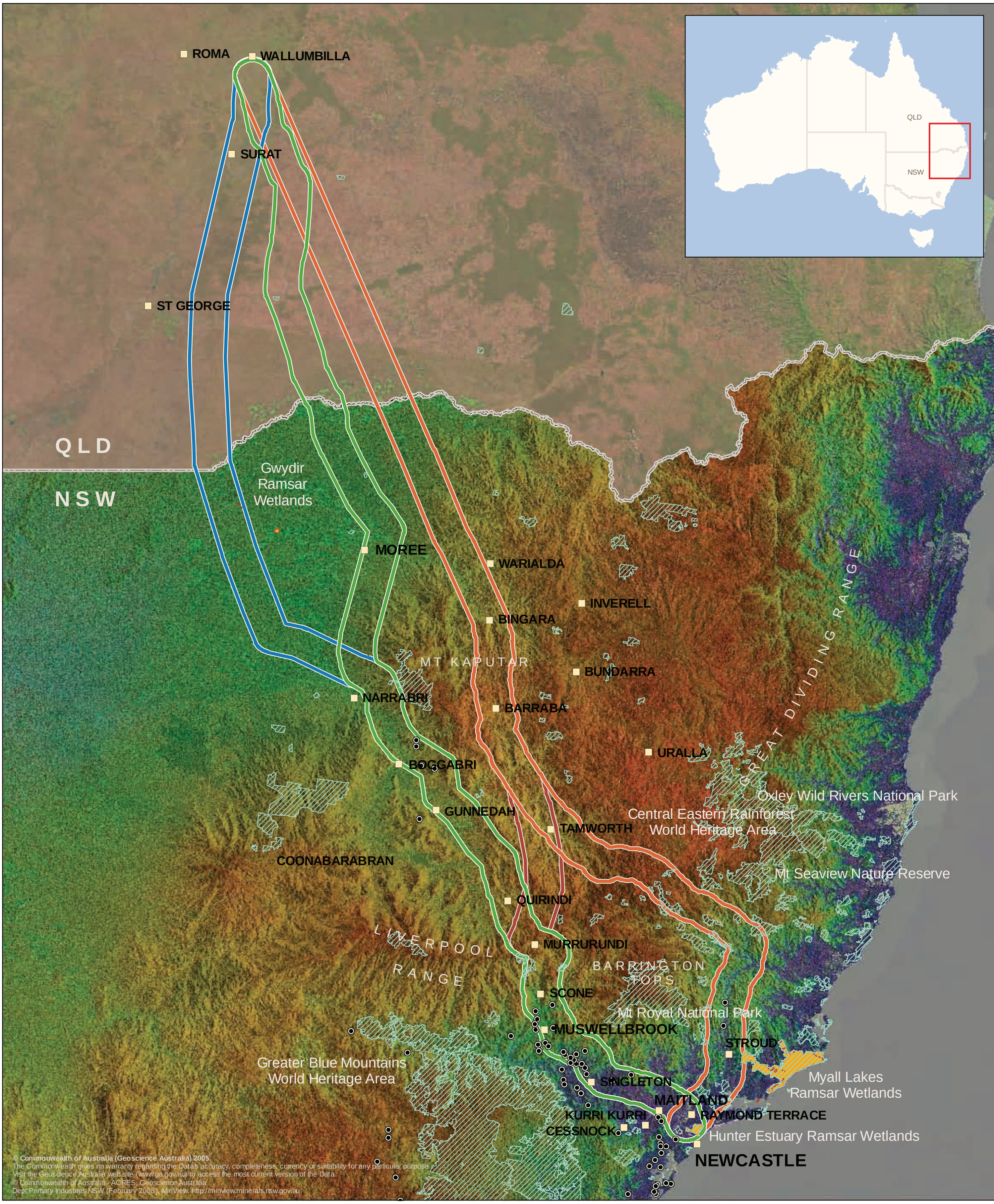
The key constraint associated with a straight-line route from Wallumbilla to Newcastle is the mountainous terrain of the Great Dividing Range between Tamworth and Tomago and associated protected areas (Barrington Tops National Park and South Eastern Rainforest world heritage sites).

From the assembled regional data and identified constraints, a series of potential general route options (20km wide) were selected (refer to Figure 3.3). A summary of these general route options and the key constraints avoided by each is provided in Table 3.3.

Table 3.3 General route options identified and key constraints avoided

Opt. No.	Name	Description	Constraint avoidance
1	Central	South from Wallumbilla to immediately east of Narrabri, then south east to Murrurundi via Boggabilla and Curlewis, then continues generally parallel with the New England Highway through Muswellbrook, Singleton and Kurri Kurri, then on to Tomago.	Avoids: • Mount Kaputar (1km to east). • Barrington Tops (15–30km to east). • Great Dividing Range. • Gwydir Wetlands (50km to west). • Greater Blue Mountains world heritage area (20km to south west).
2	Western	South west from Wallumbilla to Mungindi (on Queensland–NSW border), then south east to east of Narrabri, then the same route as Option 1.	Avoids: • Gwydir wetlands (5km to east).
3	Eastern	South east from Wallumbilla to Bingara, then follow Fossickers Way through Barraba and Manilla to Tamworth, then south east across the Great Dividing Range to the Rocks Crossing, then south west via Gloucester and Stroud to Tomago.	Avoids: • Mount Kaputar (30km to west). • Barrington Tops (2km to west). • Liverpool Range. • Gwydir Wetlands (80km to west). • Myall Lakes (1km to east). • Central Eastern Rainforest World Heritage Area (25–40km north and east). • Majority of coal mining areas.
4	Eastern alternate	Same as Option 3 up until Tamworth, then south west to join the New England Highway north of Murrurundi, then follow Option 1 to Tomago.	Avoids: • Barrington Tops (15–20km to east). • Great Dividing Range. • Myall Lakes (50km to north east).

Source: Route options – RLMS, 2004



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Date 01 September 2008

Source Geoscience Australia
NSW Dept Environment & Climate Change
NSW Dept Primary Industries
RLMS Pty Ltd

Datum GDA 94

Legend

- Central option
- Western option
- Eastern option
- Eastern alternate option
- National Park
- Ramsar sites
- Populated place
- Coal mine
- >1000m
- 0m
- Height above sea level

Queensland Hunter Gas Pipeline

Figure 3.3 General route options (20km wide)

0 20 40 60 80km

3.4.3 Assessment of general route options

The general route options were comparatively assessed based on the factors in Table 3.2 and having regard to the objectives and factors set out in Table 3.4 to form a judgement as to which route option overall best met the selection criteria.

Table 3.4 General route option assessment

Objective	Factors
Land	
Minimise community disturbance and land use conflicts.	• Number of land parcels directly affected.
Minimise disturbance to third party infrastructure.	• Local infrastructure crossings identified: • Number of major road crossings. • Number of minor road crossings. • Number of rail crossings. • Number of power easement crossings. • Number of other utility crossings.
Environment	
Avoid protected areas and areas of high ecological value.	• Area of other protected lands (eg National Parks, Nature Reserves, State Forests, etc.) • Area of remnant native vegetation.
Minimise disturbance to sensitive or unstable landforms.	• Area of acid sulphate soils. • Area of mine subsidence.
Minimise disturbance to riparian areas.	• Major watercourse crossings. • Minor watercourse crossings.
Technical and economic	
Minimise pipeline length.	• Length of pipeline.

The central option was preferred overall as, when compared to the western, eastern and eastern alternate options, it enabled:

- Fewer constraints to construction. The topography in the central option is flatter than that in the eastern alternate route option that traverses mountainous terrain.
- A more direct route than the western route.
- An economically cheaper alternative, with fewer land parcels intersected and major road crossings.
- Avoidance potential of protected land within a 20km buffer area.

Due to the potential for significant impact on pipeline constructability and cost, terrain constraints have been prioritised as one of the most important considerations for the selection of the preferred pipeline route option of 20km wide.

3.5 Preferred Study Area

3.5.1 Initial development and refinement

The central option was taken forward for further detailed study and assessment in both NSW and Queensland. The Queensland portion of the QHGP has been approved and a pipeline licence granted effective 1 May 2007.

For the NSW portion of the pipeline, the central option was refined from an area 20km wide to an area 200m wide (the Study Area) to provide an area of practical scale for assessment.

This Study Area was established based on available desktop resources of existing environmental features (as discussed above). The Study Area was refined using high quality digital imagery of the terrain and field reconnaissance by engineering and construction professionals over a number of days. This refinement was used to identify a Study Area of 200m that, on the ground, avoided where possible local constraints such as:

- Rural residential houses.
- Agricultural areas where perennial crops were evident, particularly orchards and vineyards evident in the Hunter region.
- Vegetated areas.
- Visually evident mining lease areas.
- TSRs.
- Difficult watercourse crossings, to minimise the extent of water crossings, particularly in local meandering sections of the river/creek.
- Local access routes, for properties and utilities.
- Rocky outcrops.
- Steep terrain.

In areas where it was not possible to ascertain, at ground level, how the pipeline may traverse constraining terrain and geological features, a helicopter fly-over was undertaken (see sample photo on page 3–10). Engineers experienced in pipeline design and construction undertook this aerial reconnaissance. The helicopter flight enabled identification of suitable areas for potential crossings of the steep terrain, most notably the Liverpool Ranges area. In order to cross a range area, for example, it is preferable to cross at a saddle and travel along ridges. Site specifics relating to this region are further described in the regional features section presented in
Chapter 4.

Example of terrain constraints identified from aerial overview

The Study Area was also extended to the Kooragang Island area. This was in accordance with the proposal objective to 'provide an alternative and secure gas supply to NSW, and in particular the Newcastle area' (refer to Section 2.2). The Kooragang Island area presents a significant market for existing industries to utilise gas for their operations. The protected areas of Kooragang Island and Hexham Swamp Nature Reserves were avoided in the 200m Study Area proposed in this area.

3.5.2 Study Area overview

The Study Area is shown in its entirety in Figure 3.4. The Study Area is presented using kilometre points (KP) along its entire length. The use of KP terminology is standardised for gas pipelines and will be used for the duration of the proposal, from the planning stages through construction to operation.

The 200m wide Study Area begins at the Wallumbilla gas hub and proceeds in a southerly direction towards the NSW–Queensland border. It crosses the border near the town of Boomi before proceeding south east towards Moree in central northern NSW. The Study Area passes Moree immediately to the east, where it also crosses the Gwydir and Mehi Rivers, as well as the Newell and Gwydir Highways. It proceeds south from Moree to Narrabri, where it traverses between the township of Narrabri to the west and Mount Kaputar to the east. From there, the Study Area proceeds south east towards Murrurundi, intersecting the Oxley and New England Highways, Namoi River and the Main Northern railway line.

From Murrurundi, it aligns east to avoid the Towarri National Park, turning southwards to avoid Camerons Gorge Nature Reserve, passing to the immediate west of Scone and east of Muswellbrook. The Study Area then heads south east towards Singleton, passing between the Greater Blue Mountains World Heritage Area to the south west and Barrington Tops National Park to the north east. From Singleton, the Study Area proceeds eastwards, intersecting several power transmission lines, the North Coast railway line and crossing the Hunter River before terminating at Kooragang Island at Newcastle.

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Drawing no. 07002g_CP_20-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- 20km wide central option boundary
- National Park
- Populated place
- Main road
- Railway
- Major river
- State border

Queensland Hunter Gas Pipeline

Figure 3.4 Preferred route corridor (200m wide)

0 20 40 60 80km

3.6 Ongoing Study Area refinement

The 200m wide Study Area has been selected to provide sufficient flexibility to avoid local constraints whilst allowing for a practical assessment in the early planning stages.

Additional constraints were identified as a result of specific feedback through stakeholder and landowner consultation, the environmental risk assessment (refer to Chapter 8) and findings from the matters assessed in Part B of this EA. The following details the additional constraints that were taken into account in refining the development of the Study Area.

3.6.1 Study Area alterations from landowner and stakeholder consultation

Extensive consultation has already been undertaken with all contactable landowners within the Study Area. This involved a team of experienced land agents. The land agents' work was to openly discuss the Study Area of the QHGP within the boundaries of the landowner's property, identify any constraints within the land and obtain permission for survey.

In addition, extensive stakeholder consultation has been undertaken as part of this EA with a broad range of stakeholders potentially impacted by the pipeline. Stakeholder feedback has influenced the pipeline alignment and is discussed in more detail in Chapter 6 and Appendix C.

The following table summarises issues that resulted in alignment iterations.

Table 3.5 Issues resulting in alignment iterations

Type of land use	Issues for realignment
Agricultural	• Minimise potential land use conflicts with high value agricultural land. • Minimise disturbance to sensitive use operations. • Avoid or minimise impacts on farm infrastructure such as dams, fencing, wind pumps and houses. • Improve farm creek crossings. • Avoid irrigation areas and irrigation infrastructure. • Avoid areas for agricultural expansion.
Infrastructure/commercial	• Avoid regional airports. • Avoid quarrying and mining activities. • Minimise number of railway crossings. • Avoid council bore pumps and other water infrastructure. • Following a future road corridor to minimise impacts on landholders. • Crossing road and rail at same point to reduce impacts.
Residential	• Avoid areas of potential subdivision around major regional centres.
Cultural heritage	• Avoid areas of potential indigenous cultural significance.

Type of land use	Issues for realignment
Environmental	• Improve watercourse crossings. • Minimise impact to native vegetation and riparian vegetation. • Avoid TSRs which contain remnant vegetation. • Avoid a water reservoir and allow buffer for floodway. • Avoid an approved reservoir site. • Avoid impacts on a local aquifer used as town water source. • Avoid rough terrain.

In the Murrurundi region at KP 635 and the Newcastle region at KP 815 dual Study Areas were established to explore alternative options around topographical and environmental constraints. Through ongoing Study Area refinement and stakeholder consultation the dual corridors have been reduced into a single Study Area within both regions, as reflected on Figure 4.14 and Figure 4.19 respectively.

3.6.2 Study Area alterations from environmental assessment

The EA has necessarily been carried out ahead of the detailed design phase and completion of the landowner negotiations. It is inherent in the nature of pipeline design and construction that some flexibility is required for the development of the final route alignment and as such there is a need for ongoing Study Area refinement.

Part B of this EA provides an assessment of all environmental issues relevant to the proposal. Chapter 8 provides a risk assessment that identifies those environmental issues that are considered of high (key) environmental risk to the project. The approach to the environmental assessment of key issues has been to undertake a tiered (screened) assessment of the issues. The tiered assessment methodology is defined in Chapter 8. The outcome of the tiered environmental assessment is to identify those areas within the Study Area that are of potential environmental significance, due to sensitivity or site constraints, either from construction and/or operation of the QHGP. These areas of potential environmental significance have been identified in Chapter 18 for fieldwork to determine if appropriate alignment changes or specific management and mitigation measures are required.

In accordance with the design philosophy, the hierarchy of management and mitigation measures are to:

- Avoid.
- Provide site-specific mitigation.
- Offset.

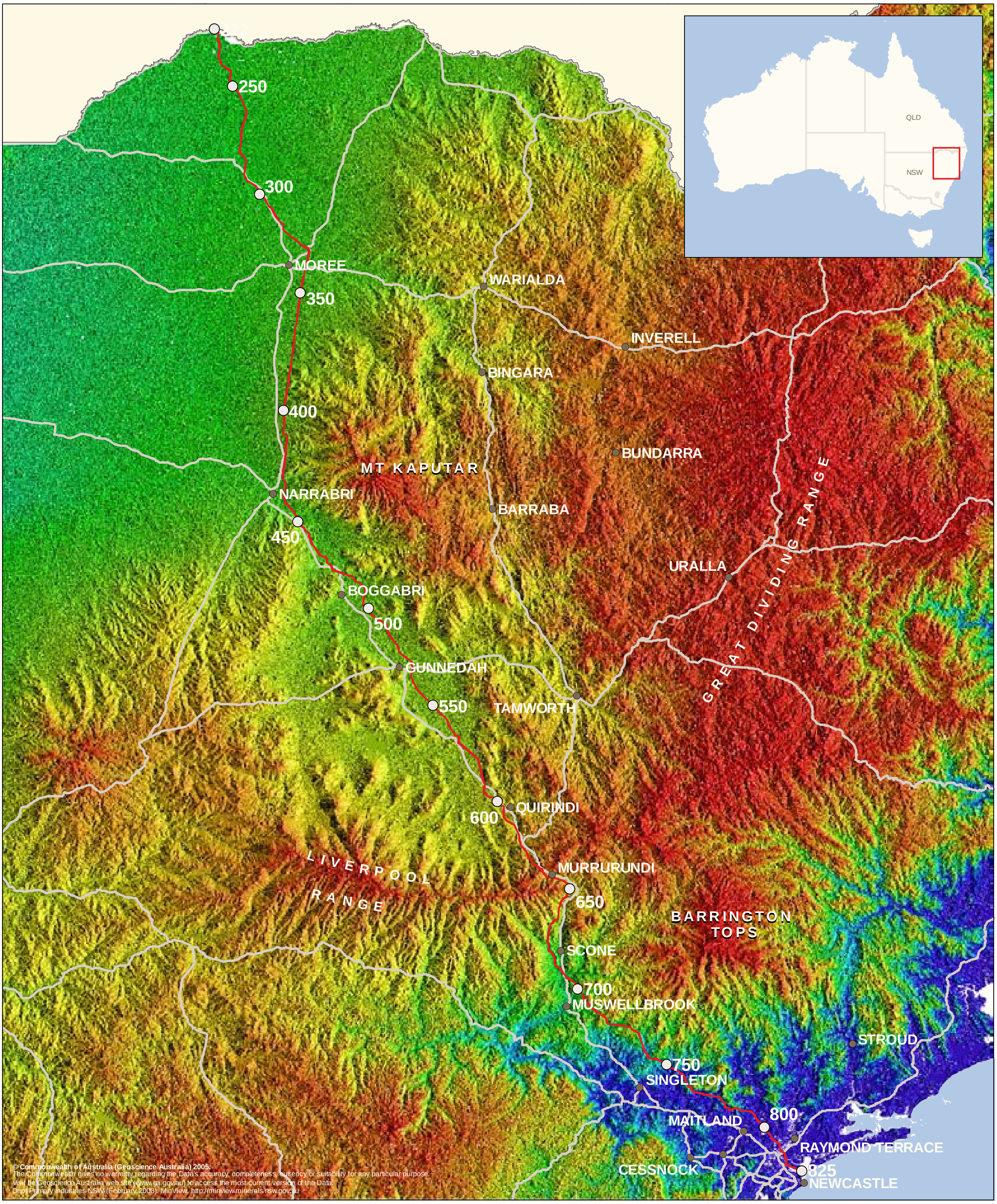
The preference would be to avoid potentially significant environmental impacts. This would therefore necessitate the need for alignment alterations after targeted field investigations have been undertaken. This particularly relates to field studies required for biodiversity and indigenous heritage issues. The final route alignment would be formalised to arrive at a 30m corridor for the proposed construction ROW and operations easement.

In summary, it is important to note that:

- Within the 200m Study Area there is flexibility for the ROW of 30m in width to avoid direct impacts on most known issues.
- The philosophy of avoidance would continually be taken into account during the design and construction phases.

4 Description of the Study Area

This chapter provides a brief description of the Study Area in NSW. The Study Area is a linear corridor of approximately 603km, generally 200m wide, traversing in a south easterly direction from the Queensland–NSW border near Boomi to Newcastle on the NSW coast (refer to Figure 4.1). As such, the Study Area passes through a variety of environments and intersects numerous linear features. As a result of the route development process discussed in Chapter 3, the Study Area is predominantly located in agricultural areas, avoiding interactions with environmentally and culturally protected areas, built up areas, major topographic features and other constraints. The Study Area includes a short lateral in the Maitland area (10.5km) and several short alternative options at specific locations, where the final pipeline route will be determined at detailed design stage.



Drawing no. 07002g_CP_21-1

Date 01 September 2008

Source Geoscience Australia
NSW Dept Primary Industries
RLMS Pty Ltd

Datum GDA 94

Legend

Kilometre point
Study Area

>1000m
0m
Height above sea level

Queensland Hunter Gas Pipeline

0 10 20 30 40km

Figure 4.1 Study area and topography

4.1 Natural environment

The proposal traverses a wide variety of environments, from south central Queensland's semi-arid lands to coastal hinterland environments near Newcastle on the NSW coast. The proposal would be located within the Darling Riverine Plains, Brigalow Belt South, Nandewar, Sydney Basin and NSW North Coast bioregions *(HSO, 2006, Thackway and Creswell, 1995)* (refer to Figure 4.2).

4.1.1 Topography, geology and soils

In the northern regions of the Study Area, the topography is generally flat or gently undulating, as the Study Area passes through lowlands to avoid minor and major topographic features, such as Mt Kaputar near Narrabri. Towards the south of the Study Area, the land becomes more undulating, however the Study Area is located in areas of lesser slope than the surrounding environment. The major topographic feature along the Study Area is the Liverpool Range, which is traversed near Murrurundi (refer to Figure 4.1).

The soils and geology vary substantially along the Study Area and have been characterised on a bioregional basis. For further reference, maps contained within Section 17.3 show the Study Area in relation to soils and geology. Within the Darling Riverine Plains Bioregion, the geology is composed of quaternary riverine deposits, primarily clays, sands and gravels. Throughout the Brigalow Belt South Bioregion, the geology is composed of both basaltic lava flows and quartz sandstones, thus resulting in differing soil and vegetation types depending upon the local parent rock type.

In the Nandewar Bioregion the geology is comprised of Jurassic and Carboniferous sediments, tertiary basalts and volcanics. The soils of the area are complex due to the differing parent materials, topography and drainage.

The geology of the Sydney Basin Bioregion is characterised by Hawkesbury Sandstone and shales of the Permian to Triassic periods underlain by the Lachlan Fold Belt. Within the NSW North Coast Bioregion a wide variety of soils are present due to the complexity of the substrates present throughout the bioregion.

4.1.2 Ecology

Darling Riverine Plains

The Darling Riverine Plains bioregion covers approximately 17 per cent of the Study Area. The dominant vegetation within this bioregion consists of woodlands and grasslands, with swamp vegetation occurring on flood plains where inundation is a regular occurrence. Along and adjacent to the Study Area, a variety of communities occur, the dominant native vegetation community is the Bimble Box dominated woodlands, these communities occur around the north of Moree and areas on the flood plains closer to the Queensland–NSW border.

Brigalow Belt South

The Brigalow Belt South bioregion covers approximately 51 per cent of the Study Area. Vegetation includes Alluvial Plains grassland and Plainsgrass grassland, with patches of Belah/Rosewood and Bimble Box dominated woodlands scattered throughout the bioregion. Stands of River Red Gum occur on major watercourses such as the Gwydir and Mehi Rivers. Some patches of Box–Ironbark/Cypress forests also occur in areas closer to the Pilliga State Forest south of Narrabri, with small patches of Myall Woodland, as well as River Red Gums along the various crossings of the Namoi River. A small section of the Study Area is located in areas where the vegetation is predominately high in modified/cleared White Box woodlands.

Nandewar

The Nandewar bioregion covers about one per cent of the Study Area. The majority of the vegetation within the bioregion consists of White Box grassy woodlands (on the lower slopes), rough-barked Apple and Yellow Box (on flats), River Oak and River Red Gum (along major streams), and patches of Red Stringybark and Red Ironbark (on steeper slopes in the east). Along and adjacent to the Study Area, highly modified stands of White Box, Yellow Box and Blakely‘s Red Gum occur.

Sydney Basin

The Sydney Basin bioregion covers approximately 19 per cent of the total Study Area. This section contains the widest variety of ecological diversity, both in terms of species and communities. Within the northern areas, native vegetation is dominated by forest and woodland vegetation, with swamp and river oak forest communities located within drainage lines. Native vegetation within the southern areas contains extensive freshwater and saltwater vegetation communities, including salt marshes, wetlands and estuarine complexes, as well as forest and woodland communities on higher slopes. In addition to these native vegetation communities, there are large areas of plantations and cleared areas associated with rural properties.

NSW North Coast

Small sections of the Study Area are located within the NSW North Coast bioregion, totalling approximately 12 per cent of the Study Area. The vegetation consists of generally dry sclerophyll forests, such as grassy woodlands, woodlands and Spotted Gum Ironbark forests.

Drawing no. 07002g_CP_22-1

Date 02 September 2008

Source RLMS Pty Ltd
NSW Dept Environment & Climate Change

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Populated place

Queensland Hunter **Gas Pipeline**

Figure 4.2 Bioregions through which the proposal would pass

0 10 20 30 40km

4.1.3 Drainage

In the north western regions of the Study Area, the landscape is flatter and the climate drier than the south eastern regions. As such, many of the watercourses flowing west from the Great Dividing Range and the New England Tablelands, which eventually feed into the Darling River catchment, are ephemeral. South of the Liverpool Ranges, watercourses are generally permanent and flow into river systems such as the Hunter, which in turn flows into the Pacific Ocean at Newcastle.

The Study Area intersects a total of 176 water features. This includes major and minor watercourses, lakes and irrigation lines. Major watercourses intersected by the Study Area include the Hunter, Namoi, Boomi, Mehi, Mooki, Gwydir and Barwon rivers. Figures 4.3–4.19 and maps contained within Appendix K show water features within and adjacent to the Study Area.

4.2 Human environment

4.2.1 Settlement and administration

Whilst the Study Area predominantly avoids built up areas, it passes near the regional towns of Moree, Narrabri, Gunnedah, Quirindi, Murrurundi, Scone, Aberdeen, Muswellbrook, Singleton, Maitland and to the immediate north of the city of Newcastle.

The Study Area is located within the LGAs of Moree Plains, Narrabri, Gunnedah, Liverpool Plains, Upper Hunter, Muswellbrook, Singleton, Maitland, Port Stephens and Newcastle. The Study Area passes through or near 11 local Aboriginal land council areas: Worimi, Awabakal, Mungindi, Toomelah, Moree, Narrabri, Red Chief, Walhallow, Nungaroo, Wanaruah and Mindaribba. In addition, numerous government and non-government agencies and boards have administrative responsibilities within the Study Area. Chapter 6 discusses the stakeholders relevant to the proposal.

4.2.2 Infrastructure

The Study Area intersects 208 identified items of infrastructure. These primarily include roads, railways, pipelines and powerlines. It is likely that other infrastructure will be encountered as the study progresses, such as underground cables identified by the dial-before-you-dig process.

The Study Area intersects a total of 34 major roads, including the Kamilaroi, Newell, Carnarvon, New England, Oxley, Gwydir and Pacific Highways. The Study Area intersects a total of nine railways, including Binnaway Werris Creek Railway, North Coast Railway, Werris Creek Moree Railway, South Western Line, Moree Weemelah Railway and Main North Railway. These are discussed in more detail in Chapter 16.

4.2.3 Land use

The Study Area is generally located in agricultural lands, with other land uses including infrastructure easements present within the Study Area. In the northern regions of the Study Area, such as Moree and Boomi, cotton production is the primary land use, whereas towards the south, in the Hunter region, agricultural lands within the Study Area are more generally used for grazing. Both of these activities are compatible with the operation of a gas pipeline. The metropolitan area of Newcastle is at the southern extent of the Study Area. The Study Area avoids all built up residential areas (refer to also to Chapter 13).

4.2.4 TSRs

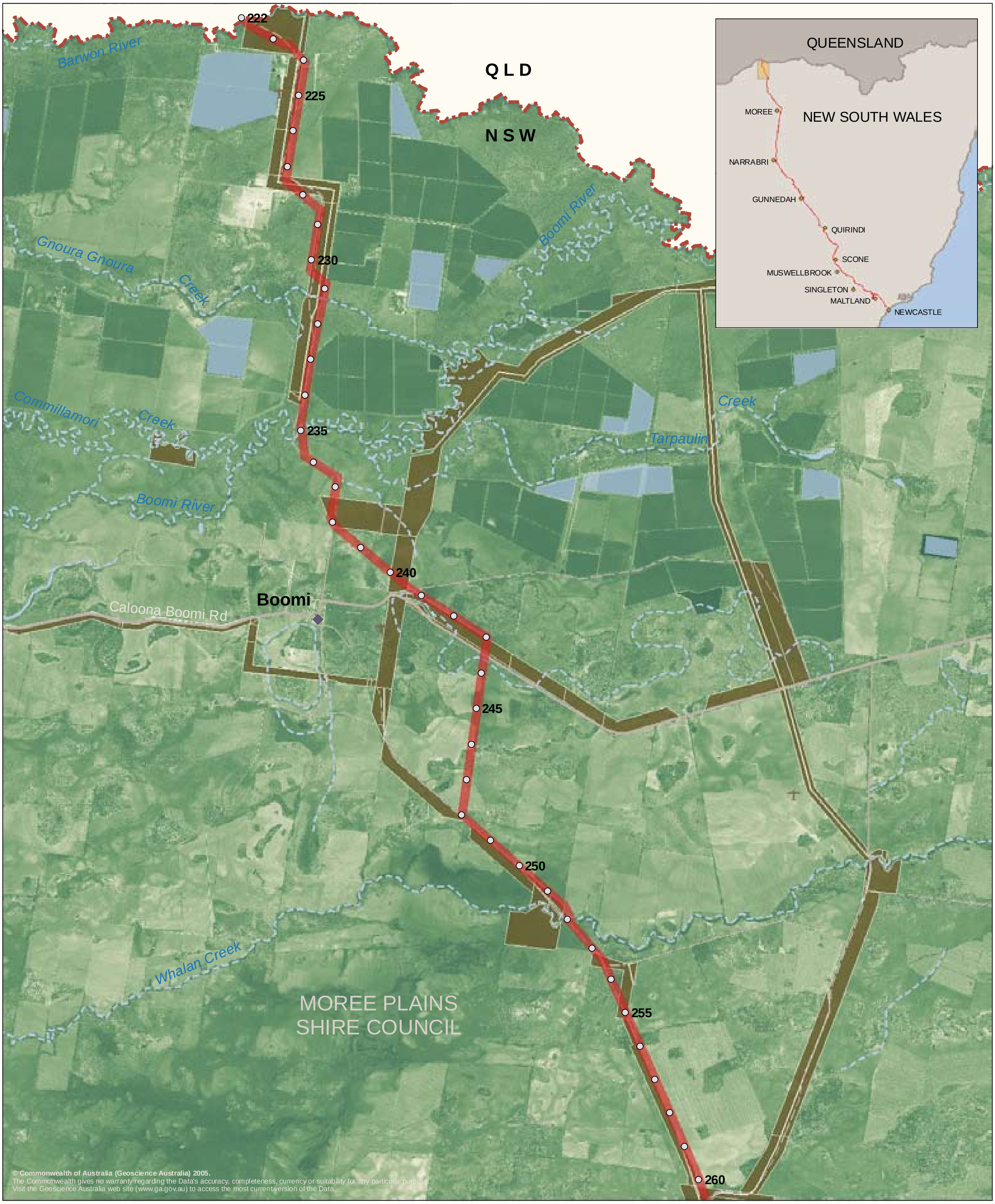
Under Clause 8 of the *Rural Lands Protection Act 1998*, a TSR means:

- Any route or camping place reserved for travelling stock route or camping place under the *Crown Lands Act 1989.*
- Any reserve for travelling stock, water reserve, reserve for access or crossing (where the reserve is for the purpose of providing travelling stock with access to or a crossing of water, whether expressly notified for that purpose or not).
- Any stock watering place.

TSRs have been generated since the 1800s as rural roads were developed and ‘pockets’ of land were left, generally adjacent to roads. TSRs are used to move stock between areas and fields and are still in use today. TSRs are administered by the Rural Lands Protection Board (RLPB). Consultation has been undertaken with the RLPB to understand issues and constraints associated with TSRs (refer to Chapter 6).

TSRs frequently contain areas of remnant vegetation. Over time, as agricultural and pastoral lands have developed in the surrounding areas, TSRs in some areas have become areas of high biodiversity value, as they may contain either threatened or vulnerable flora and fauna habitat. It is for this reason TSRs are considered, within NSW government agencies such as DECC, as areas of conservation value.

As described in Chapter 3, as part of an overall design philosophy to avoid known sensitive areas, there has been a preference for the pipeline to go through disturbed (private agricultural) lands and avoid sensitive publicly owned land such as TSRs. The Study Area has only gone through TSRs in exceptional cases where there is an explicit need to do so, such as to avoid existing infrastructure, or to cross a TSR in order to traverse parallel to it (to avoid it). Figures 4.3 to 4.19 explicitly show the areas of TSRs. They have been defined using cadastre information provided by the NSW Department of Lands (May 2008) and are identified as parcels of Crown Land.



Drawing no. 07002g_CP_01-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- Water storage area
- Travelling stock reserve
- State border
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.3 200m wide Study Area - Boomi area (KP 222-260)

1:139,982 (at A4)

0 1 2 3 4km

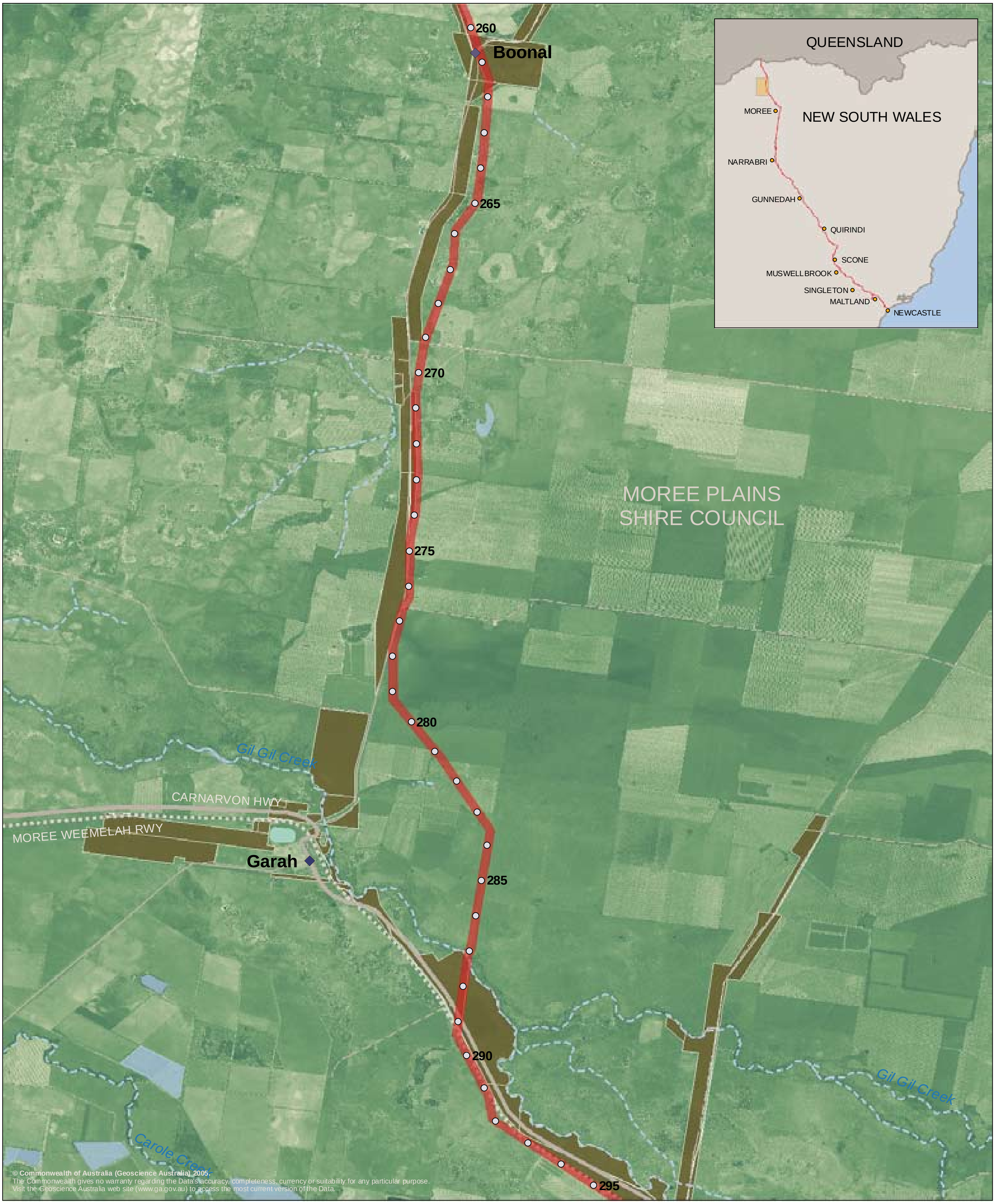
4.3 Regional overviews

4.3.1 Boomi area (KP222–260)

The Boomi landscape (refer to Figure 4.3) is generally flat and gently undulating, with the agricultural lands being traversed by rivers and creeks. The Queensland–NSW border follows the Barwon River, which crosses the north of the region in an east west direction. North of the town of Boomi lies the Boomi River and several other watercourses. However, the majority of drainage features within the region are the numerous channels associated with irrigated cotton production. These are particularly evident north of Boomi, with defined bore drains also present south of Boomi.

At the centre of this region is the town of Boomi. Other settlement within the region is limited to isolated rural properties and associated agricultural buildings, such as cotton gins. Boomi and the surrounding area have a population of about 240 (ABS Census, 2006). This region is located within the LGA of Moree Plains.

The primary infrastructure within the region is roads, with the sealed Caloona Boomi Road traversing east west intersecting at Boomi with a north–south unsealed road. Three rural landing grounds, including one at Boomi, are located within the region. Land use within the Boomi region is predominantly agricultural, with cotton farming dominating the landscape.



Drawing no. 07002g_CP_02-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Recreation area
- Water storage area
- Travelling stock reserve
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.4 200m wide Study Area - Garah area (KP 260-295)

1:140,000 (at A4)

0 1 2 3 4km

4.3.2 Garah area (KP260–295)

The Garah area (refer to Figure 4.4) is flat, with the majority of the region being utilised for broad acre agriculture. The drainage system within Garah is characterised by numerous channels and bore drains associated with the agricultural and cotton industries active in the area. Gil Gil Creek is the main watercourse, with a small number of other creeks and tributaries scattered throughout the region.

The region is located within the LGA of Moree Plains. Located adjacent to the Carnarvon Highway and Moree Weemelah Railway line is the town of Garah, which is the main settlement in the region. Garah is an agricultural centre with a population of about 350 people (ABS Census, 2006). Other settlement within the region is limited to isolated agricultural properties associated with the regional cotton, sheep and beef cattle industries.

The Carnarvon Highway is the main sealed road located within the region and the Study Area crosses at KP289. A secondary sealed road connects Garah with Boonal in the north of the region. Various other unsealed roads are located within the region. The Moree Weemelah Railway line runs parallel to the Carnarvon Highway.

Drawing no. 07002g_CP_03-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Water storage area
- Travelling stock reserve
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.5 200m wide Study Area - Ashley area (KP 295-335)

1:140,000 (at A4)

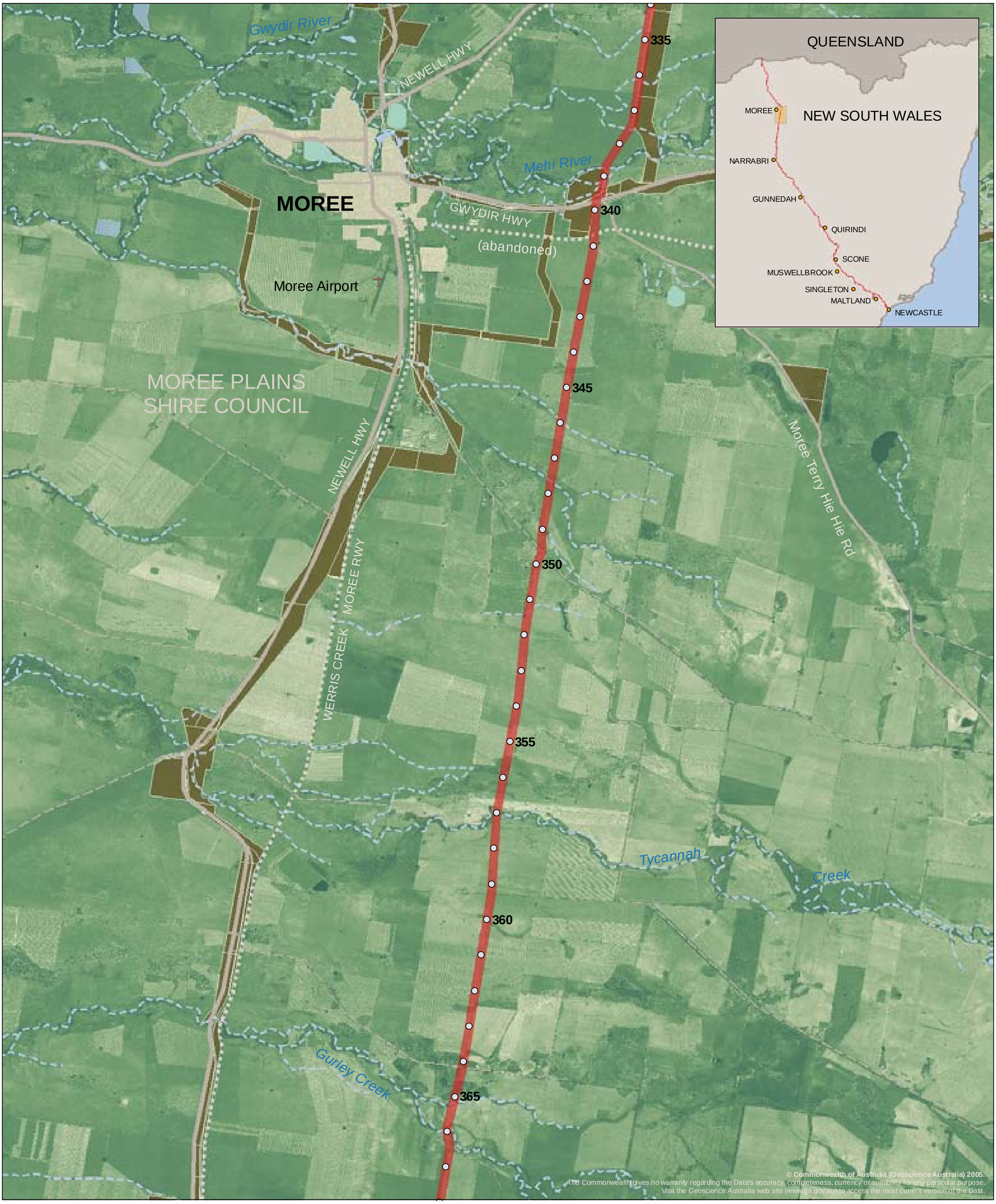
0 1 2 3 4km

4.3.3 Ashley area (KP295–335)

The Ashley area (refer to Figure 4.5) is characterised by a flat landscape with a complex system of drains and channels, associated with the irrigation needs of the region's cotton industry. There are various watercourses crossing through the region including Gil Gil Creek, Wallon Creek, Marshall Ponds Creek and the Gwydir River. In the south west corner of the region is the Gwydir Raft – a log-jam that extends approximately 35km along the Gwydir River. Midkin Nature Reserve is located to the south west of Ashley.

The region of Ashley is located within the LGA of Moree Plains. Ashley is the main settlement located within the region with a population of about 270 people (ABS Census, 2006). The town is serviced by the Carnarvon Highway and is bordered to the west by the Moree Weemelah Railway. Located near Ashley are the Auscott cotton gin and the Ashley cotton gin, which reflect the strong cotton industry operating in the region. South of Ashley is the smaller settlement of Yarraman and the former OTC Satellite Earth Station. Various quarries can also be found scattered throughout the region.

The Carnarvon and Newell Highways are the primary sealed roads located in the Ashley region. Various other unsealed roads are located throughout the region. The Moree Weemelah Railway line runs from the north west corner of the region south east towards the town of Camurra. Three rural aircraft landing grounds are located within the region, including one at Ashley.



Drawing no. 07002g_CP_04-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- Recreation area
- Water storage area
- Built up area
- Travelling stock reserve
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.6 200m wide Study Area - Moree area (KP 335-367)

1:140,000 (at A4)

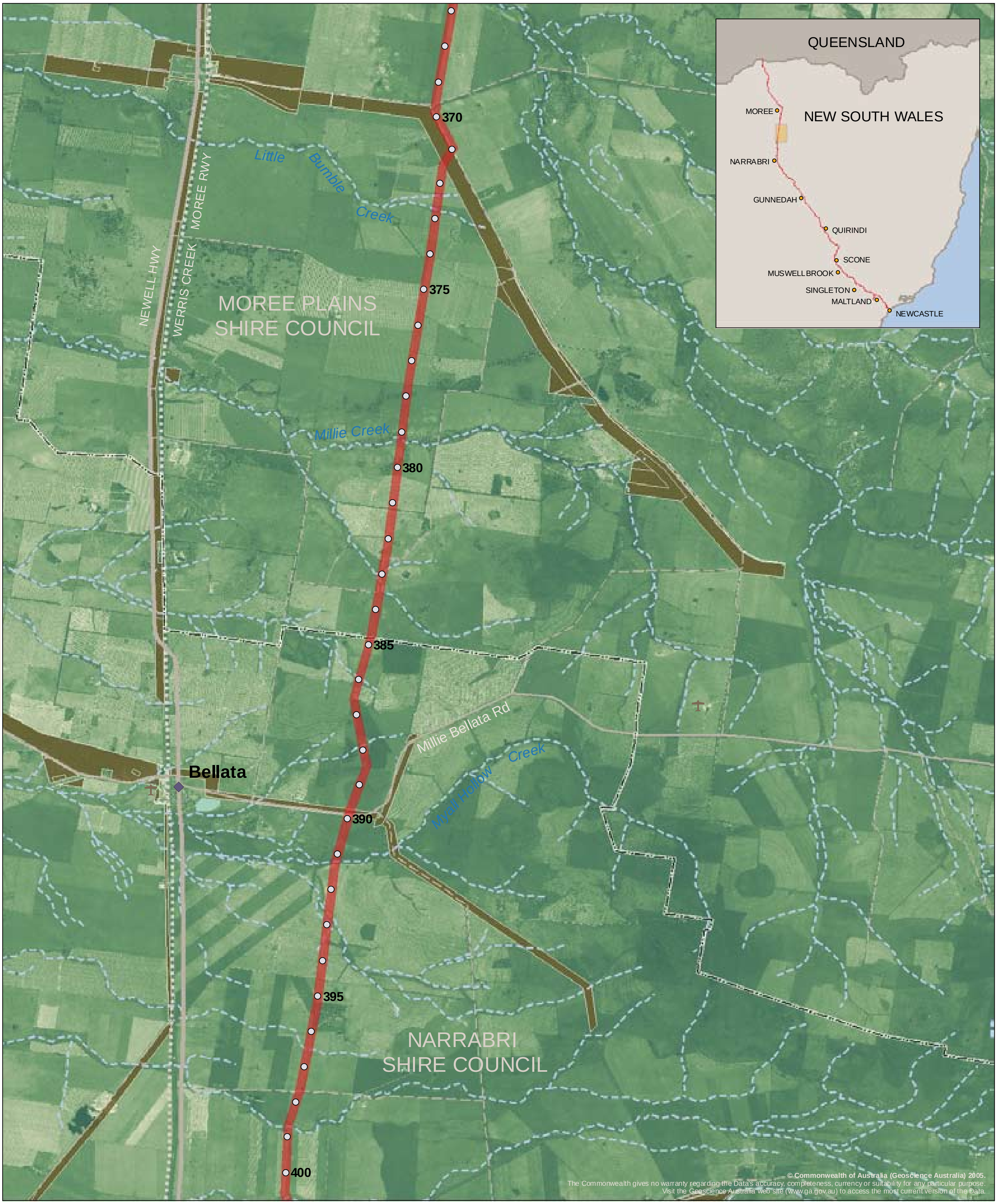
0 1 2 3 4km

4.3.4 Moree area (KP335–367)

The Moree region (refer to Figure 4.6) is flat, dominated by the flood plains of several creeks and rivers. Moree is located at the junction of the Mehi and Gwydir Rivers. Downstream of Moree, the Gwydir River divides into two major streams known as the Gingham Watercourse (northern arm) and the Lower Gwydir or Big Leather Watercourse (southern arm) (Border Rivers–Gwydir Catchment Management Authority, 2007). Other watercourses passing through the region include Tycannah Creek and Gurley Creek, both of which are located south of Moree.

The town of Moree is the largest settlement located within the Moree region with a population of about 9,700 (ABS Census, 2006). Located within the LGA of Moree Plains, Moree is at the junction of several major highways. Grain, cotton, sheep and cattle are the major industries operating in the region. The racecourse, substation, sewage treatment works, and recreational facilities such as the Moree golf course and rifle range, are evidence of the significance of this town as a regional centre.

The Gwydir and Newell Highways, which intersect at Moree, are the two main roads located within the Moree region. The Moree Airport and Moree wheat subterminal are located south of Moree. Heading south from Moree is the Werris Creek Moree Railway. Other infrastructure located within the region includes a substation and sewage treatment works, both of which are located in close proximity to Moree.



Drawing no. 07002g_CP_05-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- Recreation area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary rRoad
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.7 200m wide Study Area - Bellata area (KP 367-400)

1:140,000 (at A4)

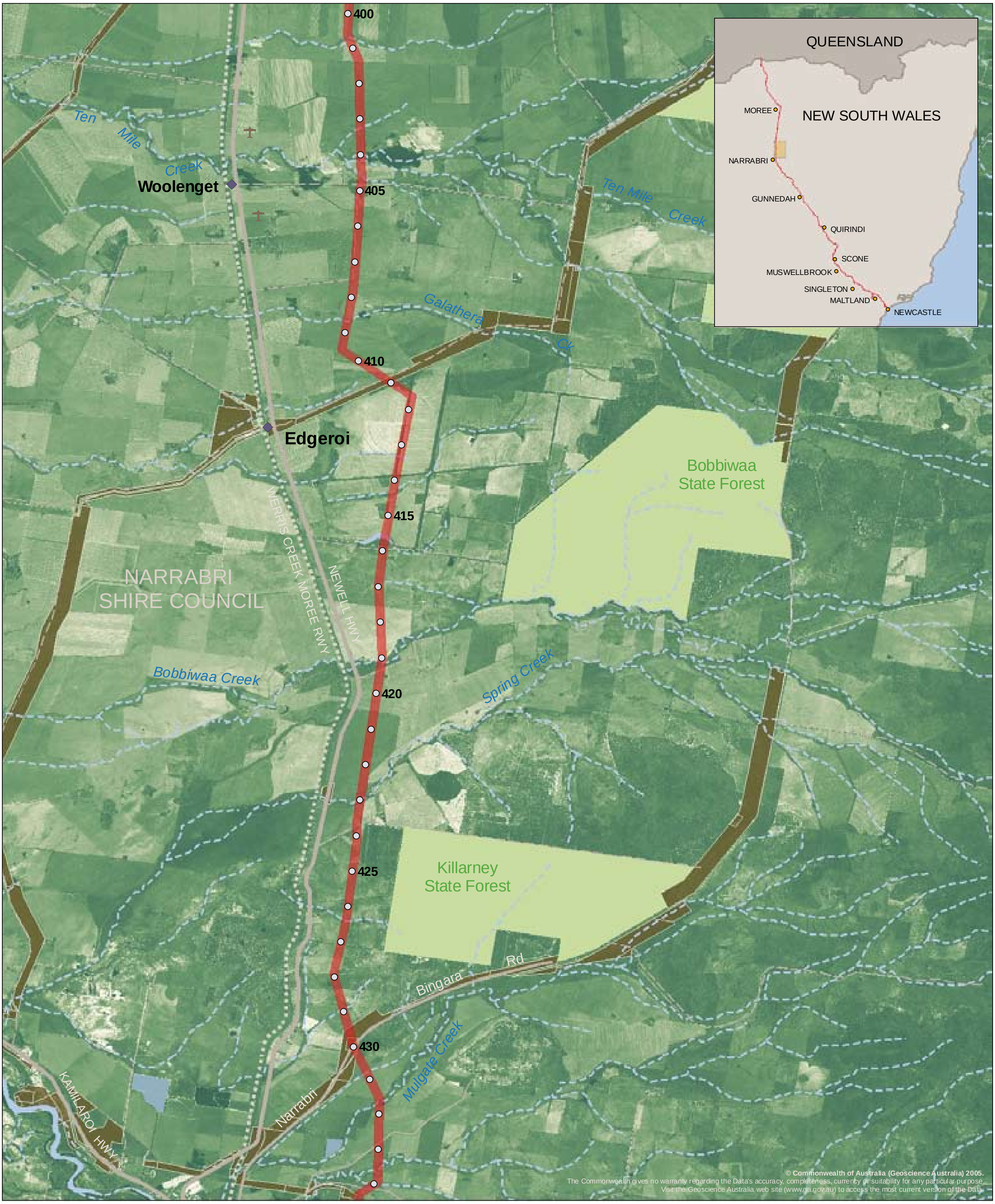
0 1 2 3 4km

4.3.5 Bellata area (KP367–KP400)

The Bellata area (refer to Figure 4.7) is generally flat, with a few hills rising from the plain in the east. The Bellata region is characterised by a number of creeks, including Myall Hollow Creek, running east to west, south of Bellata.

Bellata is the largest settlement located within the Bellata region with a population of about 530 (ABS Census, 2006). Bellata is located on the Newell Highway and adjacent to the Werris Creek Moree Railway. The Bellata region is an important grain production area and the town of Bellata is home to a large grain storage complex. The region is located within both the Narrabri and Moree Plains LGAs.

The Newell Highway is the primary sealed road located within the Bellata region. Various secondary unsealed roads are located throughout the region. The Study Area intersects with Millie Bellata Road at KP390. Other infrastructure located within the region includes a substation and two rural landing grounds.



Drawing no. 07002g_CP_06-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Water storage area
- Travelling stock reserve
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.8 200m wide Study Area - Narrabri north area (KP 400-434)

1:140,000 (at A4)

0 1 2 3 4km

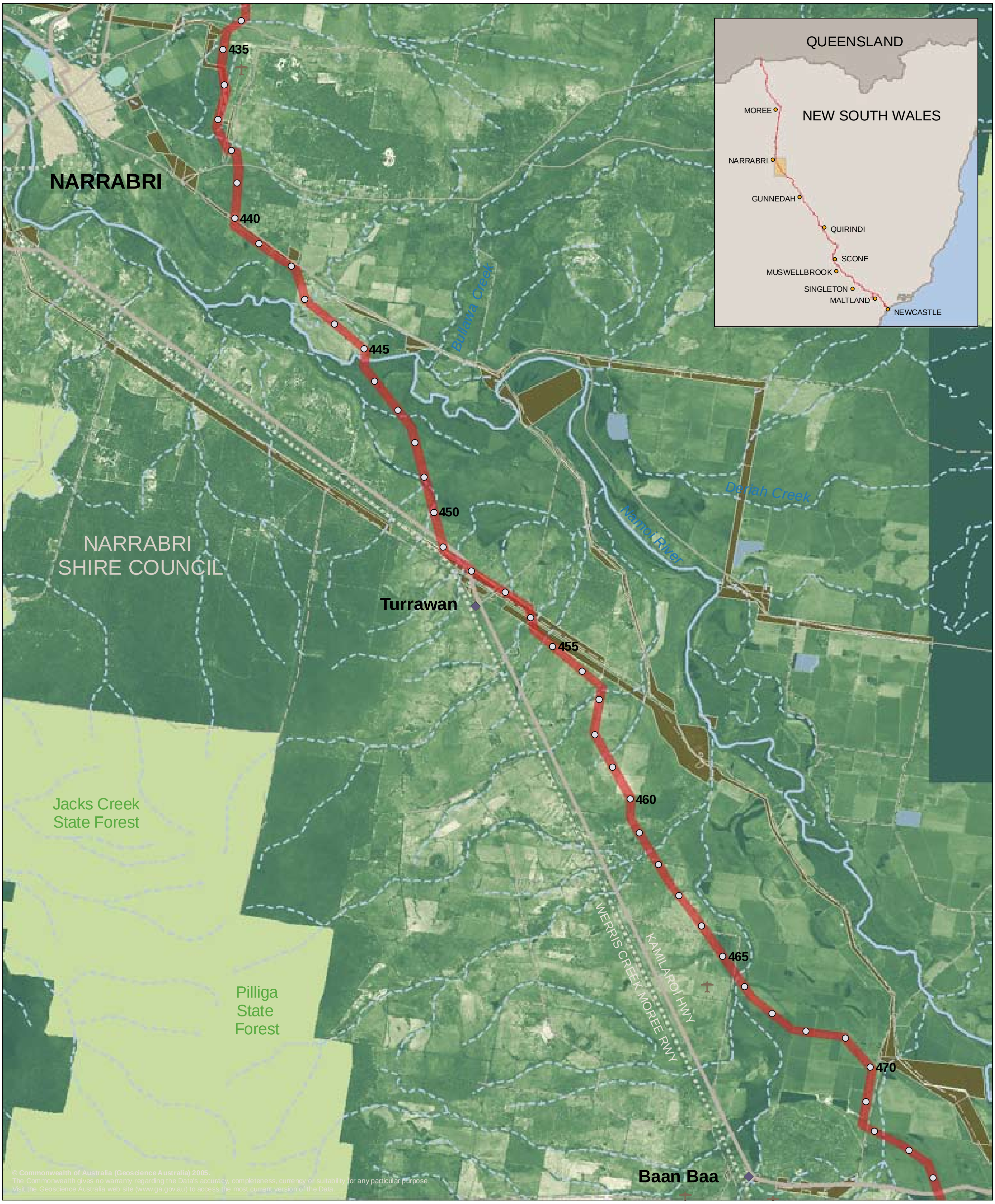
4.3.6 Narrabri North area (KP400–435)

The Narrabri North area (refer to Figure 4.8) is dominated by agricultural lands, as the region is flat in the west and gently undulating in the east. Bobbiwaa and Killarney State Forests are also located within the region.

The drainage system within the Narrabri North region consists of various creeks that traverse in an east to west direction. These include Ten Mile Creek, Bobbiwaa Creek, Spring Creek and Mulgate Creek.

Settlement within the Narrabri North region consists of isolated rural properties and agricultural buildings. The small village of Edgeroi, located approximately 26km north of Narrabri on the Newell Highway, serves as a community centre for the local agricultural industry. Numerous silos are located throughout the region to support the local wheat and grain industries. The Narrabri North region is located within the Narrabri Shire Council area.

The Newell Highway is the main sealed road located within the Narrabri North region. The Werris Creek Moree Railway line runs parallel to the Newell Highway. In the northern end of the region near Woolenget, are two rural landing grounds.



Drawing no. 07002g_CP_07-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Recreation area
- Water storage areas
- Built up area
- Travelling stock reserve
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.9 200m wide Study Area - Narrabri area (KP 434-474)

1:140,000 (at A4)

0 1 2 3 4km

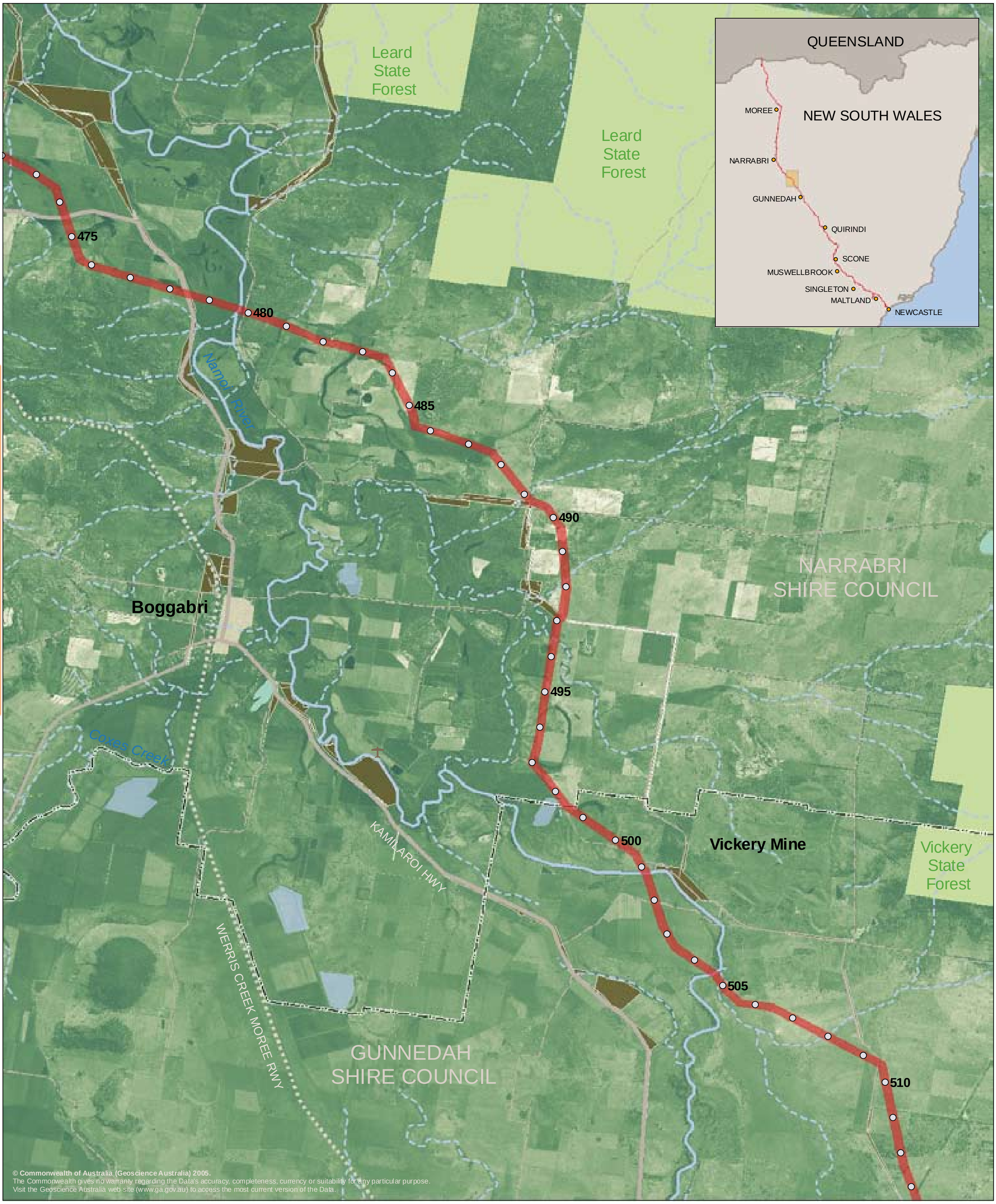
4.3.7 Narrabri area (KP434–474)

The Narrabri area (refer to Figure 4.9) is generally flat along the Namoi River valley, gently rising to the east and west. Jacks Creek State Forest and Pilliga State Forest dominate the south west corner of the region. The township of Narrabri, with associated quarries, sewage treatment works, aerodrome and other major facilities is located in the north west. The remainder of the region is generally agricultural.

The Namoi River runs through the Narrabri town centre and is the main watercourse in the Narrabri region. Also located within the western portion of the Narrabri township is Narrabri Lake. Throughout the region are numerous channels used for local agricultural production. Flowing into the Namoi River are various creeks including the Bullawa and Deriah Creeks.

The main settlement within the Narrabri region is the town of Narrabri, which has a population of about 7,500 (ABS Census, 2006). Narrabri is a regional centre serviced by supermarkets, retail facilities, and health and emergency services. In the region outlying the main township are numerous farms producing cotton, wheat and cattle. South east of Narrabri is the small village of Turrawan and further south is the town of Baan Baa. The Narrabri region is located within the LGA of Narrabri.

The Kamilaroi Highway is the primary sealed road located within the Narrabri region. Running parallel to the highway is the Werris Creek Moree Railway line. The junction of the Narrabri North, Narrabri South and Narrabri West Railway lines is located west of the Newell Highway and Kamilaroi Highway intersection. Other infrastructure located within the region includes the Narrabri aerodrome and an additional rural landing ground north of Baan Baa.



Drawing no. 07002g_CP_08-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Recreation area
- Water storage area
- Built up area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.10 200m wide Study Area - Boggabri area (KP 474-513)

1:140,000 (at A4)

0 1 2 3 4km

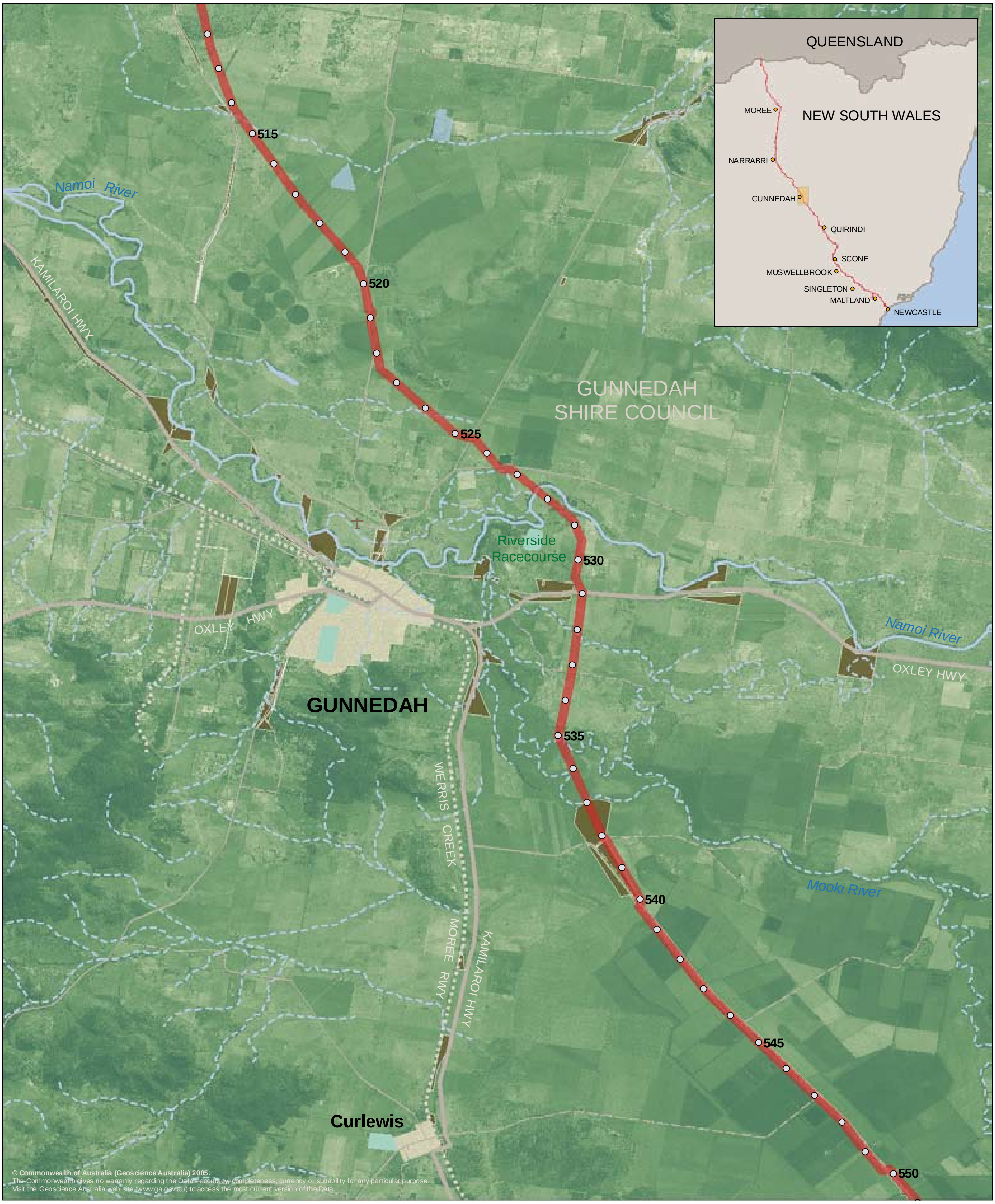
4.3.8 Boggabri area (KP474–513)

This area (refer to Figure 4.10) is predominantly gently undulating. The flatter areas have been used for agriculture, whilst within the steeper areas in the north east is located the Leard State Forest. Quarries and the Vickery Mine are also located within the region.

The drainage system within the Boggabri region is largely focussed around the Namoi River. The Namoi River runs from the north western corner of the region, east of Boggabri, down to the south eastern corner. Coxs Creek lies south of Boggabri and runs to the south west of the region off the Namoi River.

The town of Boggabri is the largest settlement in the Boggabri region and has a population of about 1,000 (ABS Census, 2006). Boggabri is located about 60km south east of Narrabri and lies alongside the Kamilaroi Highway and the Werris Creek Moree Railway. Other settlement within the region includes outlying agricultural properties and cotton gins. The Boggabri region is located within the Narrabri LGA.

The primary infrastructure located within the Boggabri region is the Kamilaroi Highway. The Study Area intersects the highway at approximately KP477.5. Several secondary unsealed roads extend from Boggabri to the outlying agricultural areas.



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Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
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Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- Recreation area
- Water storage area
- Built up area
- Travelling stock reserve
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 4.11 200m wide Study Area - Gunnedah area (KP 513-550)

4.3.9 Gunnedah area (KP513–550)

The Gunnedah area (refer to Figure 4.11) is generally flat. In the south west and north east of the region, several peaks rise from the plain. The plains have generally been used for agriculture, with the steeper and higher areas more vegetated with native species. Areas of hard rock have been quarried, with several disused and operating quarries located throughout the region. Also, the region is located on one of the largest underground coal seams in NSW.

The Namoi and Mooki Rivers are the major watercourses flowing through the Gunnedah region and much of the region lies within a natural floodplain. The Study Area crosses the Namoi River at KP527.5.

The Gunnedah township is the largest settlement located within the Gunnedah region and has a population of about 8,000 (ABS Census, 2006). Gunnedah is an important regional centre supporting a diverse regional agricultural industry. Curlewis is the largest outlying village located in the region with a population of about 750 (ABS Census, 2006). The Gunnedah region is located within the Shire of Gunnedah.

The Gunnedah region is serviced by the Oxley and Kamilaroi Highways, which intersect in the Gunnedah town centre. The Study Area crosses the Oxley Highway at KP531. Other infrastructure located within the region includes an aerodrome at Gunnedah.

Drawing no. 07002g_CP_10-1

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Legend

- Kilometre point
- Study Area
- NSW estate
- Water storage area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 4.12 200m wide Study Area - Breeza area (KP 550-589)

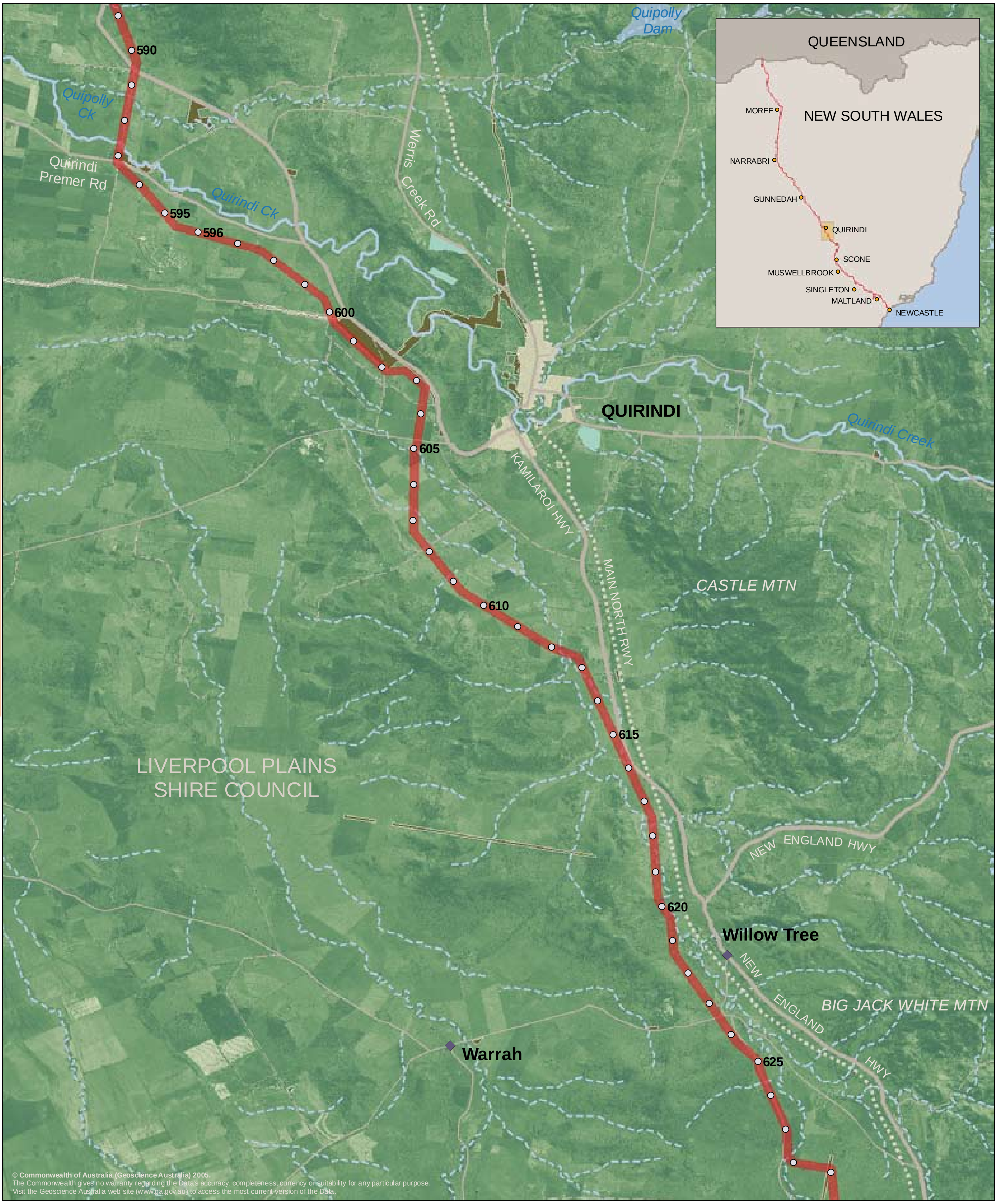
4.3.10 Breeza area (KP550–589)

The Breeza area (refer to Figure 4.12) is generally flat, with minor peaks such as Mt Watermark in the west and Piallaway Needles. These higher areas are more vegetated, with the plains used for agricultural purposes. The Doona State Forest is located in the south west of the region.

The Mooki River is the major watercourse located within the Breeza region. The Mooki River traverses the landscape in a north–south direction and is crossed by the Study Area at KP565.5. Tributaries connected to the Mooki River include Werris Creek and Quirindi Creek. The latter runs south east towards the town of Quirindi.

The small villages of Breeza and Caroona are the predominant areas of settlement within the region of Breeza. In the 2006 Census, Breeza had a recorded population of 132 and Caroona had a recorded population of 178 (ABS Census, 2006). Wheat production is one of the primary industries within the Breeza region and various grain silos have been built throughout to support this industry. The Breeza region is located within the LGAs of Gunnedah and Liverpool Plains.

The Kamilaroi Highway is the main road located within the Breeza region. Rail infrastructure includes the Werris Creek Moree Railway and the Binnaway Werris Creek Railway. The Study Area intersects these railway lines at KP579 and KP583 respectively.



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Datum GDA 94

Legend

- Kilometre point
- Study Area
- Recreation area
- Water storage area
- Built up area
- Travelling stock reserve
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.13 200m wide Study Area - Quirindi area (KP 589-629)

1:140,000 (at A4)

0 1 2 3 4km

4.3.11 Quirindi area (KP589–629)

The topography of the Quirindi area (refer to Figure 4.13) is predominantly gently undulating, with Castle Mountain and Big Jack White Mountain the major features in the south and east of the region. The lower regions are generally used for agriculture, with the steeper and higher lands more densely vegetated.

The Quirindi region is located within the Namoi River catchment. Quirindi Creek is the main watercourse located within the Quirindi region. Quirindi Creek runs from the north west corner of the region towards the south east, and is intersected by the Study Area at KP593. To the north of the region is Quipolly Dam, which is known as a sanctuary for a wide variety of bird species.

Quirindi town centre, with a population of about 3,000 (ABS Census, 2006), is the major settlement within this Quirindi region. Numerous agricultural settlements are also scattered along Quirindi Creek. South of Quirindi is the village of Willow Tree with a population of about 170 (ABS Census, 2006). The Quirindi region is located within the Liverpool Plains Shire Council area.

The Kamilaroi Highway and the New England Highway are the main roads located within the Quirindi region. Various secondary and unsealed roads branch out from these main roads to smaller surrounding rural towns and villages. The Study Area intersects with the Kamilaroi Highway at approximately KP590 and the Quirindi Premer Road at KP593. Other transport infrastructure within the region includes the Main Northern Railway, which runs from the north to the south.

Several quarries and the Castle Mountain Mine are located near the town of Quirindi, with the more outlying areas being used for agriculture.

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Date 01 September 2008

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Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Built up area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.14 200m wide Study Area - Murrurundi area (KP 629-673)

1:140,000 (at A4)

0 1 2 3 4km

4.3.12 Murrurundi area (KP629–KP673)

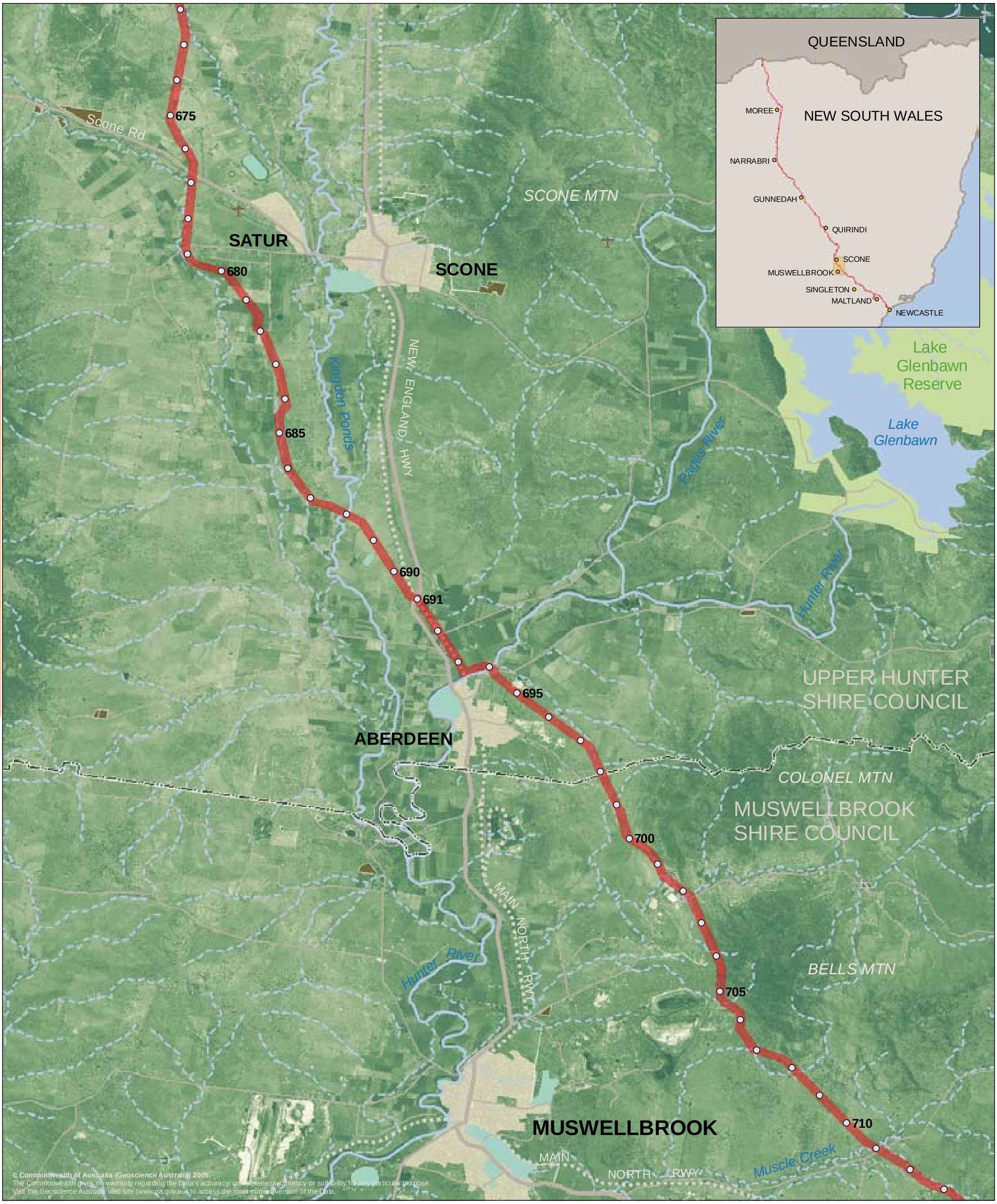
The Murrurundi area (refer to Figure 4.14) is dominated by the Liverpool Range, the most significant topographical feature encountered along the Study Area. Narrow river valleys cut through the range, with most development occurring in these lower lying areas. Land use within the region is varied, with agricultural lands, mines and quarries, such as Middle Brook mine and Ardglen quarry, located in the lower lying areas. Towarri National Park and Wingen Maid Nature Reserve are located in the heavily vegetated areas of the steep slopes and ranges. Major peaks within the region include Mount Pleasant, Black Mountain and Square Mountain, with the latter rising to 1,150m above sea level.

Topographical constraints and identified quarries and mines within the region created difficulties during the development of the Study Area around the town of Ardglen. In the course of ongoing refinement, dual Study Area corridors were established at KP635 to explore alternative options. Through further consultation with landowners and stakeholders, a single Study Area has now been selected to follow the old New England Highway over the Liverpool Ranges.

Running from the north of the Murrurundi region is the Warlands Creek, which feeds into the Pages River near Blandford. South of Murrurundi are various watercourses, including the Petwyn Valley Creek, which is intersected by the Study Area at KP658.5. Further south are the Kingdon Ponds, which lie adjacent to the New England Highway.

The town of Murrurundi is the largest settlement within the region and has a population of about 800 (ABS Census, 2006). Other townships within the region are Ardglen, Blandford, Wingen and Parkville. The Murrurundi region is located in the Upper Hunter LGA.

The New England Highway is the main sealed road located within the Murrurundi region. The highway and the Main Northern Railway follow the main river valley of the region. Various secondary and unsealed roads branch off the New England Highway to outlying areas. A rural landing ground is located south west of Murulla.



Drawing no. 07002g_CP_13-1

Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Recreation area
- Water storage area
- Built up area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 4.15 200m wide Study Area: Muswellbrook area (KP 673-712)

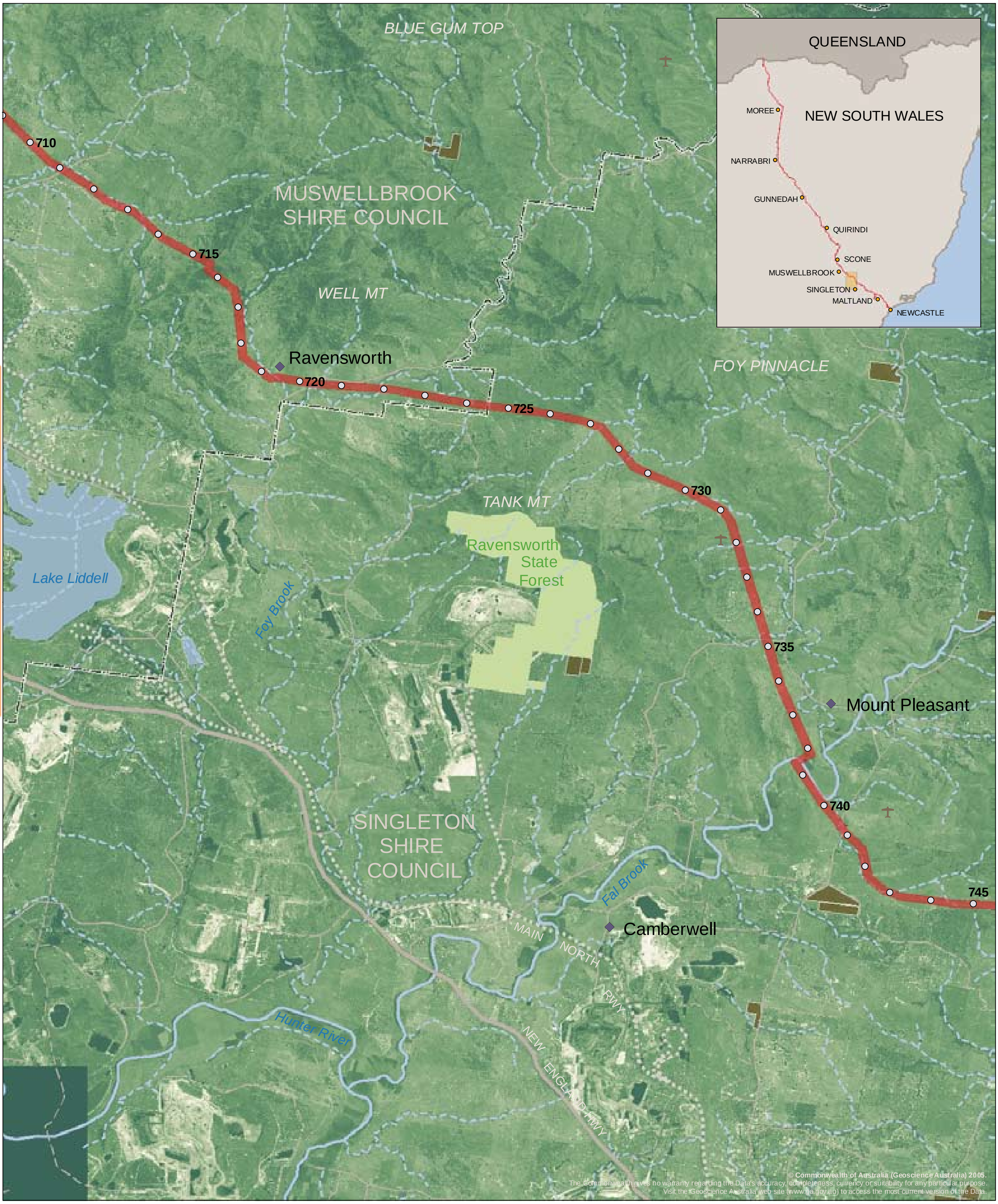
4.3.13 Muswellbrook area (KP673–712)

The Muswellbrook area (refer to Figure 4.15) is predominantly comprised of gently undulating lands. Scone, Colonel and Bells Mountain features are situated away from the rivers and appear in the landscape rising several hundred metres above the river valleys. In the north east of the region lies the Glenbawn Dam and the associated Lake Glenbawn state recreation area, which is highly vegetated.

The Muswellbrook region is located within the Hunter–Central Rivers Catchment and contains a complex system of creeks, rivers and other water bodies. The Hunter River flows from Lake Glenbawn in the north east corner of the region before being intersected by the Study Area at KP694. The Hunter River continues south, past Aberdeen, through to the west side of Muswellbrook. Muscle Creek flows off to the east of the Hunter River, through the Muswellbrook town centre.

The town of Muswellbrook, with a population of about 11,000 (ABS Census, 2006), is the largest settlement within the region. The town, which lies east of the Hunter River along the New England Highway, is developed with residential dwellings, local schools, a hospital and numerous other facilities. The town is surrounded by a number of mines and quarries, with the majority of residents living in Muswellbrook being employed in the mining industry (ABS Census, 2006). North of Muswellbrook are the smaller towns of Aberdeen, Scone, and Satur, the latter having a population of about 5,000 (ABS Census, 2006). There are also several significant horse stud properties within this region. The Muswellbrook region is located in the Muswellbrook Shire.

The New England Highway is the main sealed road located within the Muswellbrook region, running through the centre of the region from the north to the south. The Main Northern Railway runs parallel to the New England Highway. The Study Area intersects the New England Highway at KP691 and through the Main North Railway at KP690. Scone Road, a sealed road running north west from Scone, is intersected by the Study Area at KP677. Other infrastructure within the region includes substations near Muswellbrook and McGullys Gap.



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Date 01 September 2008

Source Geoscience Australia
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Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Water storage area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

Figure 4.16 200m wide Study Area - Singleton north area (KP 712-742)

1:140,000 (at A4)

0 1 2 3 4km

4.3.14 Singleton North area (KP712–742)

Singleton North is predominantly a coal mining area (refer to Figure 4.16) with about 18 coal mines operating in or nearby the region. Topography is generally flat to gently undulating in the south, rising to steep slopes and mountainous areas in the north, associated with igneous formations. Features such as Well Mountain, Tank Mountain, Foy Pinnacle and Blue Gum Top are evident in these northern areas.

The Singleton North region is located within the Hunter–Central rivers catchment and contains a large number of minor watercourses. The Study Area crosses Foy Brook at KP721 and Fal Brook at KP739. Lake Liddell, and the associated Lake Liddell dam and power station, are located in the region's west.

The main areas of settlement in the region are at Mount Pleasant, Camberwell and Ravensworth. Mount Pleasant is the most heavily populated of these areas, with a population of about 900 (ABS Census, 2006). The region is located in the Singleton and Muswellbrook Shires.

The New England Highway is the main road infrastructure contained within the Singleton North region. The Main Northern Railway enters the region north of Lake Liddell and heads south east. Other infrastructure contained within the region includes various unsealed roads branching off the New England Highway to the various mines located throughout the region.

Land use within the region is dominated by mining. Mines located within the region include Mount Owen, Ravensworth East, Ravensworth–Narama, Liddell, Hunter Valley, Lemington, Rix's and Camberwell. Ravensworth State Forest is located in the centre of the region and several quarries are located throughout.

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Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- Recreation area
- Built up area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Major river (perennial)
- Minor river (non-perennial)
- Railway

Queensland Hunter Gas Pipeline

Figure 4.17 200m wide Study Area - Singleton east area (KP 742-770)

1:140,000 (at A4)

0 1 2 3 4km

4.3.15 Singleton East area (KP742–770)

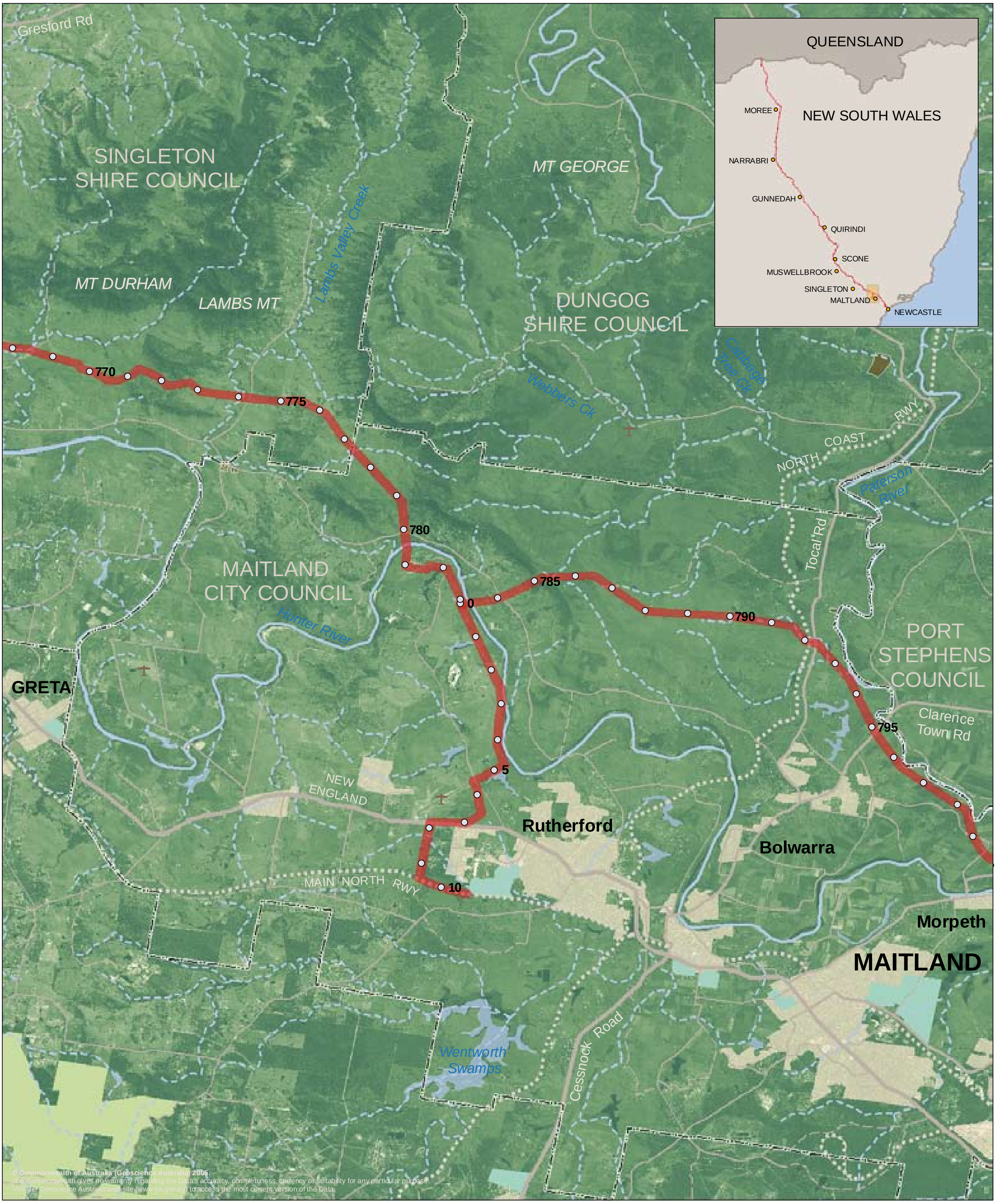
The Singleton East area (refer to Figure 4.17) is predominantly rural, with agriculture dominating the lower lying areas in the south of the region around the Hunter River and the gently undulating areas in the north. Igneous rock formations in the north and east of the region form features such as Mount Dyrring and Tangory Mountain. Native vegetation dominates the areas not used for agriculture, generally in the higher and steeper areas on the north and east of the region.

The region is located within the Hunter–Central Rivers catchment. The Hunter River runs from the west to the east of the region, passing through the Singleton urban centre. The Study Area intersects Glendon Brook at KP756. Various waterholes are scattered throughout the region.

Singleton and Branxton are the two major settlements located within the Singleton East region. The urban centre of Singleton is located to the west of the region and has a population of about 14,000, whilst Branxton, located in the south east corner has a population of about 2,000 (ABS Census, 2006). The Singleton East region is located in the Singleton LGA.

The New England Highway is the primary road located within the Singleton East region. The Main Northern Railway runs parallel to the New England Highway. Various sealed and unsealed roads traverse the region. Other infrastructure located within the region includes several rural landing grounds, including landing grounds at Singleton and Branxton.

Whilst the region is generally agricultural, the urban areas of Singleton and Branxton, as well as numerous homesteads, are located in the south of the region near the Hunter River. Quarries are located throughout the region and an army training area is located in the south west.



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Date 01 September 2008

Source Geoscience Australia
NSW Deptartment of Lands
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Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Recreation area
- Water storage area
- Built up area
- Travelling stock reserve
- LGA boundary
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 4.18 200m wide Study Area - Maitland area (KP 770-797)

4.3.16 Maitland area (KP770–797)

The Maitland area (refer to Figure 4.18) is a combination of urban and rural areas, with built-up areas and agricultural lands concentrated on the flatter, flood plain areas associated with the Hunter River and its tributaries. Away from the river the area becomes more vegetated as the topography has limited agricultural use, with features such as Mount George, Mount Durham and Lambs Mountain standing out within the landscape. Similarly, the geology of lower lying areas is predominantly of a sedimentary nature, with basalt substrate forming the ridges and mountainous terrain in the north of the region.

The region is located in the Hunter–Central Rivers catchment area. The major watercourse located in the region is the Hunter River, which enters the region from the west. Also located in the west of the region near Branxton–Greta are numerous farm dams. Various creeks run through the region including Lambs Valley Creek, Webbers Creek and Cabbage Tree Creek. In the south of the region are the Wentworth Swamps.

The town of Maitland, located on the New England Highway, is the largest settlement within the Maitland region. Maitland, which is a satellite city to Newcastle as well as being a regional centre in its own right, has an urban centre population of about 60,000 (ABS Census, 2006). Aside from residential development spread throughout the Maitland region, the region also has agricultural buildings and quarries. The Maitland region is located within the Maitland and Singleton LGAs, with the Dungog Shire, which the Study Area would not traverse, located in the north of the region.

The New England Highway is the primary road located in the Maitland region. Other major roads in the region include Cessnock Road, which links Maitland with the town of Kurri Kurri. The Northern Railway traverses the region in an east west direction, meeting the North Coast Railway at Maitland, which then proceeds northwards. Four rural landing grounds are located throughout the region.

Land use within the region is highly varied, with built-up areas of residential, commercial and industrial uses around the town of Maitland. Built-up areas also follow the New England Highway westward throughout the region. Agricultural lands dominate the more outlying areas of the region, which also contains numerous quarries and their associated infrastructure. An industrial estate also located within this region has been considered in relation to the lateral at KP783 for future services.

Drawing no. 07002g_CP_17-1

Date 01 September 2008

Source Geoscience Australia RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Recreation area
- Water storage area
- Built up area
- LGA boundary
- Major road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 4.19 200m wide Study Area - Newcastle area (KP 797-825)

4.3.17 Newcastle area (KP797–825)

The Newcastle area (refer to Figure 4.19) is centred around the valley of the Hunter River, with the city of Newcastle at the river's mouth. The region consists of a complex system of swamps, rivers, creeks and other waterways. In the north east corner of the region is Grahamstown dam, situated north of Raymond Terrace. The Study Area crosses the Hunter River at two locations. Several nature reserves are located within the region and are generally associated with swamps and other flood plain features. These include Hexham Swamp Nature Reserve, McClement Swamp, Eskdale Swamp, Woodbury Swamp, Kooragang Nature Reserve and Glenrock State Conservation Area.

The main settlements located within the region include Newcastle and Raymond Terrace. The Newcastle urban centre has a population of about 290,000 (ABS Census, 2006). The Study Area would traverse the Newcastle, Port Stephens and Maitland LGAs within this region.

Newcastle is a heavily urbanised and industrial area. Kooragang Island, in the centre of the region, is the location for the Kooragang Coal Terminal. An aluminium smelter is located at Tomago (KP814–815).

At KP815, ongoing stakeholder consultation has assisted in refining the dual Study Area corridors into a single Study Area option. The selected Study Area will now be contained within the Tomago infrastructure corridor and will be guided by Kooragang Island conservation officers.

The New England Highway and the Pacific Highway are the primary roads within the Newcastle region. A substantial network of sealed roads is located throughout the region, linking Port Newcastle with surrounding residential and industrial areas. Newcastle Airport and Williamstown RAAF base are located in the east of the region. Two additional rural landing grounds can be found near Beresfield and Thornton.

5 Proposal description

This chapter provides a description of the design, construction, commissioning and operational activities associated with the proposed pipeline including a lateral from the main line to Maitland. The information contained in this chapter has been used to provide an understanding of all the activities that may result in potential impacts to the surrounding environment. Measures to reduce potential impacts are inherent in the design, construction and operation procedures for the pipeline and, where applicable, this has been noted in this chapter.

5.1 Pipeline design

5.1.1 Key principles for design

The proposed pipeline would be designed and constructed in accordance with the current version of *AS2885 – Pipelines Gas and Liquid Petroleum.* This standard covers the design, construction and operation of gas transmission pipelines in Australia. *AS2885* calls up in excess of 80 Australian, American and European standards in accordance with which the pipeline and facilities must be designed.

The design can be broken down into two main activities:

- Risk assessment – including route selection, third party activities, future development, erosion, flooding and land movement.
- Pipeline design – including steel and coating selection, valve spacing, depth of burial, corrosion protection, alternative current (AC) interference, remote monitoring, operations and maintenance.

APIA Code of Environmental Practice

In addition to meeting regulatory requirements and guidelines, in designing the proposal the proponent has drawn on the Code of Environmental Practice developed by the APIA. The APIA Code provides comprehensive guidance on the best techniques and methods presently available to mitigate or eliminate the environmental impact of onshore pipeline activities. The APIA Code is based on the collective knowledge and experience of the pipeline industry and aims to achieve the highest standards of protection. A core element of the proposal is that the APIA Code has helped to form the Study Area and pipeline design, and approaches to construction and operation of the pipeline. The APIA Code is consistent with principles for ESD (APIA Ltd, 2005).

Risk assessment

At the commencement of design, a risk assessment database is developed which identifies all of the potential risks associated with the pipeline. The design then has to ensure that all the risks are mitigated to an acceptable level. Examples of risks that influence design are:

- Land use, such as:
  - Deep ripping or blade ploughing.
  - Irrigation.
  - Future mining.

  - Road or urban development.
  - Cultivation, such as vineyards or orchards.
- Landslip areas.
- Flooding or erosion.
- Utility activities, such as:
  - Power, water and communications.
  - Road and rail maintenance (particularly table drain deepening).

A preliminary risk assessment has been carried out and this is addressed in Chapter 14. This would be updated during the detailed design phase.

Pipeline design

The size and operating pressure of the pipe is first determined based upon the potential gas market and commercial viability. Once the pipeline operating pressure is determined the steel strength and thickness is selected (refer to Table 5.1). Coupled with this is the selection of the most suitable corrosion protection coating and supplementary corrosion protection system.

Table 5.1 Pipeline specifications

Pipeline component	Design specification	

Length:
• NSW
  • Mainline
  • Lateral (Maitland area)
• QLD
• Total mainline
	Approximately:
	
	• 603km
	• 10.5km
	• 222km
	• 825km	

Diameter	Main line – approximately 500mm Maitland area lateral – approximately 300mm	
Wall thickness:	12.7mm minimum	
Material	API5L – X65 or X70 = carbon steel, X70 means that the pipe has a yield strength of 70,000 psi	
Coating	Fusion bonded epoxy or other recognised system such as High Density Polyethylene	
Depth cover	In rock	May be reduced to 600mm in urban areas, and 450mm in rural areas providing rock occurs over a continuous 50m.
	Generally	750mm
	Deep cultivated areas	1200mm
	Road/rail crossings	1200–2000mm
	Watercourse crossings	1200–2000mm
Nominal Capacity	85PJ/a	
Maximum Operating Pressure	15.3Mpa	

Pipeline component	Design specification
Construction Right of Way (ROW)	30m average
Corrosion Protection	External coating and cathodic protection (CP) system
Non-Destructive Testing (NDT)	100 per cent radiographic inspection or ultra sonic of welded joints
Supervisory Control and Data Acquisition (SCADA)	Pipeline monitoring back to a control centre

Included in the design, as a result of the risk assessment process would be requirements for additional protection measures which may include heavier wall pipe in more vulnerable locations, increased depth of cover, installation of concrete slabs, buried marker tape and additional signage. The pipeline would be buried at a depth to be determined based on the requirements of *AS2885 Part 1 Design and Construction of Pipelines – Gas and Liquid Petroleum*. The minimum requirement for normal excavation is 750mm cover. At watercourse crossings the depth of burial is dependent on the nature of the watercourse and the geology at the site.

Of particular importance is prevention of damage through third party interference with the pipeline. This is mitigated through appropriate depth of cover, signposting of the pipeline, one call 'dial before you dig' programs (where available), regular inspection of the easement to spot any construction or earthmoving activities in the area, as well as education of landholders and the community of the potential dangers of carrying out activities in proximity to the pipeline.

In some areas, such as road crossings, additional protection may be provided to reduce the risk of third party interference (eg marker tape buried above the pipeline, physical barriers such as concrete slabs or thicker wall pipe). Security fencing, gates and locks would be provided around all aboveground facilities (eg scraper stations and meter stations) to inhibit accidental or unauthorised tampering.

5.1.2 Gas quality

Gas transported in the pipeline would comply with Australian Standard *AS4564 – 2003 Specifications for Pipeline Quality Gas Supply.*

The typical analysis for the gas to be supplied is given in Table 5.2.

Table 5.2 Typical coal seam methane

Component	Mole per cent
Methane	96.5
Nitrogen	2.75
Carbon Dioxide	0.75
	Value
Gross Heating Value MJ/m^3	36.5
Specific Gravity	0.57

Source: RLMS, 2008

Part A

5.1.3 Ancillary infrastructure

Aboveground facilities for the pipeline may include:

- Mainline valves (MLVs).
- Scraper launcher and/or receiver stations.
- Meter stations.
- Communication towers.
- CP facilities.

The number and location of these items has not been determined at this stage and would form part of the detailed design phase of the proposal. The following sections provide a description of the each of the ancillary pieces of infrastructure that are associated with the pipeline.

MLVs

The principal purpose of MLVs is to enable isolation of sections of the pipeline to reduce the volume of gas released in the event of damage or programmed maintenance. MLVs typically occupy a fenced and gravelled area of 250m^2 and would be installed near an access road away from populated areas as best as possible. MLVs would also be located away from watercourses and environmentally sensitive areas.

The MLVs would be strategically spaced depending upon land use. In rural areas, MLVs would typically be about 50km apart. In areas classified as rural residential, spacing would typically be 30km, and about 15km apart near the built-up area of Newcastle.

The MLVs may be operated manually on site or from a remote control centre via the SCADA system. Additionally, some MLVs would be equipped with automatic line break detection, which would allow the valve to automatically close in an unlikely event of pipeline failure.

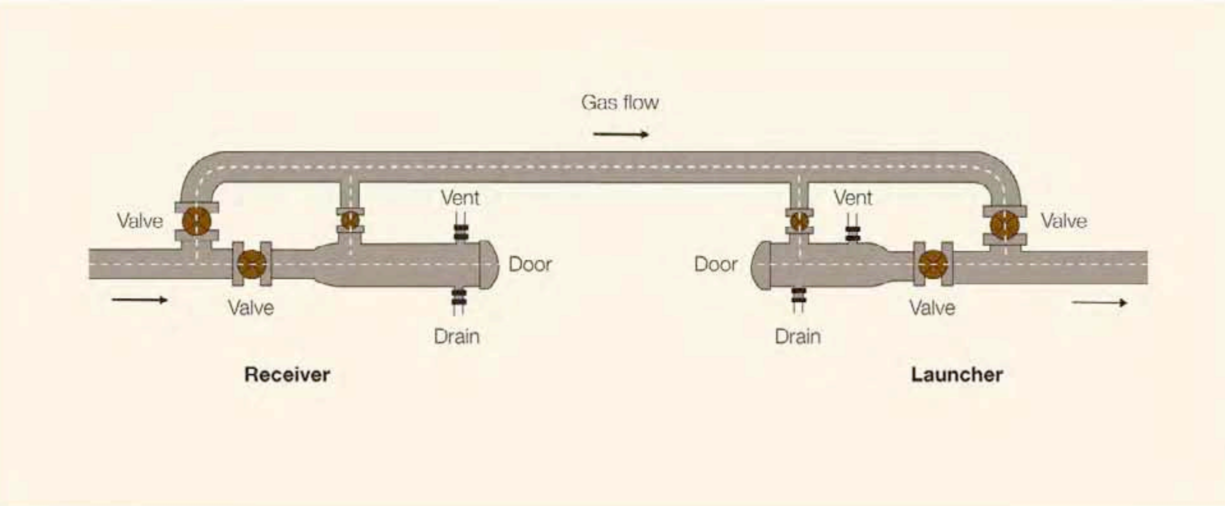
Main line valve

Scraper stations

Scraper stations allow the insertion and/or retrieval of devices (known as 'pigs') to clean the internal sections of the pipe or to detect damage or metal loss within the pipe. Scraper stations would contain MLVs as well as isolation valves located on the launcher and receiver to isolate them during normal operation. Figure 5.1 shows a typical scraper station arrangement.

Up to seven intermediate scraper stations spaced between 100 and 150km apart may be required for the length of the ROW (with five to six located in NSW). The scraper stations would be installed within the same fenced area as a MLV, thus being located away from populated and/or environmentally sensitive areas.

Figure 5.1 Schematic of a typical scraper station



Compressor stations

Compressor stations are not included as part of the proposal, as the free flow of gas is deemed sufficient to address the initial demand. Compressor stations may be required in the future to facilitate increased gas flow with increasing gas demand. Installation of any compressors would be subject to a separate approvals process.

Meter stations

Meter stations would be constructed at sites where gas enters or leaves the pipeline. Meter stations include equipment to measure the volume of gas transferred and, at off take points, equipment to adjust temperature and pressure. They are typically located away from any significant development and occupy an area of approximately 2,500m^2. Access to power, grid or solar, would be required to operate metering, communications and instrumentation equipment.

Pipeline design would take into account potential future pipeline laterals and associated meter facilities. At locations where it is probable that a future lateral would be located, a tee with a side valve may be installed in the mainline. These may be located within the same fenced areas as the MLVs and would allow for easier future connections into the mainline. These potential future off takes would be sited using input from LGAs and potential users.

CP facilities

The primary corrosion protection is provided by the pipeline coating. A low voltage direct current (DC) impressed current or similar CP system would be installed on the pipeline to provide a secondary form of corrosion protection for the pipeline. The secondary system would consist of small power rectifiers and anode beds that would maintain the pipe at a negative potential to prevent corrosion should the coating become damaged. Test points would be located at approximately 3–5km intervals along the pipeline to allow monitoring of the pipeline and CP system.

The impressed current system would generally be located, as required, within the MLV fenced yard. The system may be run by solar power with battery backup, eliminating the need to locate the MLV facility near power supplies.

Table 5.3 Criteria for locating associated pipeline infrastructure

Location criteria	Mainline valve	Scraper station	Meter station
Environmental			
More than 100m from a waterway	Yes	Yes	Yes
Area of low ecological and heritage conservation significance	Yes	Yes	Yes
No substantial clearing of native vegetation required	Yes	Yes	Yes
Distance from dwellings or other sensitive receivers	100m	100m	100m
Engineering			
Easy and safe access to road network	Yes	Yes	Yes
Access to grid power	Not required	Not required	Yes

Note: CP facilities may be located within a MLV facility.

5.1.4 Tie-ins and connection points

Future intakes are possible from other CSG resources as a result of successful petroleum exploration adjacent to the pipeline or to deliver gas to customers at points along the pipeline route. Potential connection points (off takes) may be built into the pipeline at construction, or added to the pipeline system during operation, through a process known as ‘hot-tapping’. The addition of off takes to the pipeline would be dependent on future market opportunities.

The facilities for off takes are likely to be a similar area to a MLV and scraper station site and would consist of pressure and flow regulation and metering equipment at points of gas reception or delivery. Where practical, off takes and their associated metering/pressure reduction equipment would be installed within the same fenced yard as a MLV. Provision would be made to install tees and side valves at key market locations.

The ability to provide future connections to the pipeline, to either add or take gas into or out of the pipeline, helps to underpin the socio-economic advantages associated with the pipeline. These have been discussed in Chapters 2 and 12.

5.2 Materials procurement

5.2.1 Pipe sourcing and delivery

Pipe would be sourced either within Australia or overseas depending upon the final diameter of the pipe and supply availability. The pipe would be pre-coated at an existing coating plant before delivery to the ROW. There would be no pipe coating facility as part of the proposal and extent of proposed works.

Once delivered, the pipe would then be transported by road and/or rail to a location in proximity to the ROW. The exact location for delivery would be determined at detailed design stage. However, at this stage, it is known that two pipe storage facilities would be located both to the north and south of the Liverpool Ranges, to service the proposed construction spreads (refer to Section 5.4).

Pipe would then be taken from the pipe storage facility by truck, for delivery to the ROW. Handling of the pipe is minimised as far as practicable to avoid damage to the pipe coating. A small stockpile of 5–10 days supply of pipe may be set up at strategic locations to avoid delays during construction.

Section 11.5 discusses the delivery of pipe in relation to traffic related impacts.

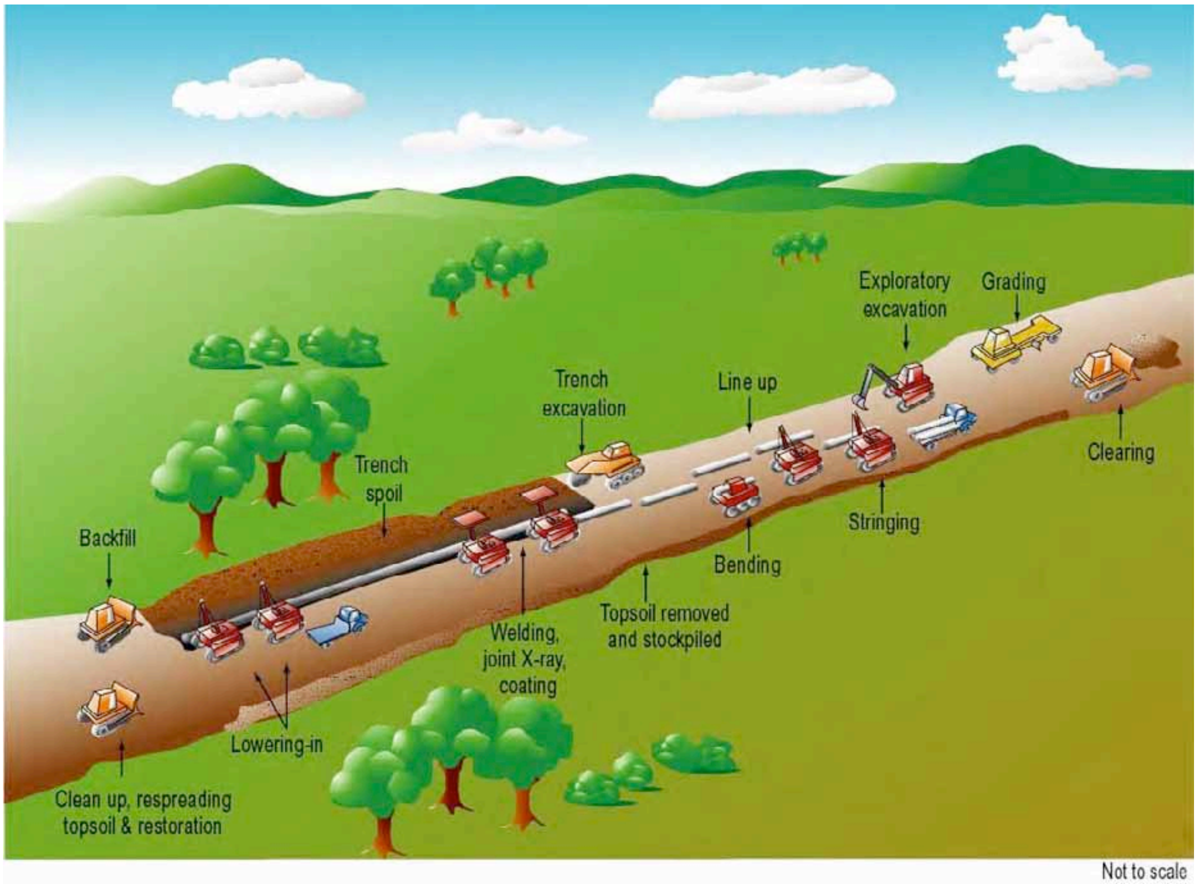
5.2.2 Other materials

Other materials would include valves, pre-fabricated pipe bends, meters, regulators, welding rods, fencing, gravel, and concrete. These would again be sourced locally or overseas depending upon availability and transported directly to site.

5.3 Pipeline construction activities

Pipeline construction involves a repetitive sequence of a number of activities which must be carefully planned, scheduled and integrated to function as a continuous production process: survey and fencing, set up of temporary facilities, clear and grade of the ROW, trenching, pipe stringing and bending, pipe welding and inspection, joint coating, pipe placement in the trench (lowering in and laying), backfilling and compaction, hydro-testing and reinstatement. Each activity has a nominated crew composed of personnel and equipment required to carry out the task. The crews collectively are referred to as a ‘spread’.

Figure 5.2 Pipeline construction sequence



Source: Western Pipeline Project, McConnell Dowell

Blasting would be required to form the trench in areas of rock. This is anticipated to total less than ten per cent (45km) of the length of the pipeline and would be concentrated in the Liverpool Ranges and in some areas on the northern edge of the Hunter Valley region. Key characteristics of the construction program are given in Table 5.4.

Table 5.4 Construction program characteristics

Construction element	Details
Width of vegetation clearing	Generally 30m
Depth of trench to provide the minimum depth of cover required under *AS2885*	Rural, non cultivated areas 1,250mm Deep cultivated areas 1,700–2,500mm Road crossings 1,700mm Creeks/rivers 2,500mm
Construction workforce	Approximately 600 (300 spread)
Construction spreads	Two main spreads plus a smaller crew for special crossings and difficult areas.
Construction hours	The majority of works would be undertaken from 7am – 6pm with the exception of those works that are required to be undertaken over prolonged periods, extending into nighttime hours.

Construction element	Details
Standard work cycle	28 days on and nine days off
Mainline construction duration (approximate)	Eight months
Refuelling	Mobile fuel truck and construction depot
Normal time between clear and grade and reinstatement	Up to four months

5.3.1 Construction hours

The industry standard for cross country pipeline construction is 28 days on and then nine days off. The nine days off enables demobilisation and remobilisation of construction camps, as well as specialist crew to return to their homes. The majority of the construction work will be undertaken in rural areas away from sensitive receivers (see Chapter 11). Where construction noise is audible at sensitive receivers, consultation with impacted residents will be undertaken 48 hours in advance of work and during the local construction period as necessary. Blasting would be scheduled to occur between 9am and 5pm Monday to Saturday. No blasting will occur on Sundays and public holidays.

Construction works would be undertaken between 7am and 6pm, seven days a week for 28 days and then nine days off, except in the following instances. Extended construction hours may occur where:

- The horizontal directional drill (HDD) rig is in operation. Once the drill rig is in operation, it has to keep running until the HDD bore is complete. This may result in extended work hours beyond daylight hours, including 24 hour operations. Chapter 15 identifies those watercourse crossings that have been nominated as requiring HDD.
- Boring is in operation, and until the completion of the infrastructure boring. This situation is similar to HDD, as boring must continue until completion as the integrity of the bore is compromised should drilling cease midway (potential subsidence). Chapter 16 identifies those infrastructure crossings that have been nominated as requiring boring.
- The water filling of the pipeline and pumping pressure is required to be obtained for hydro-testing. Hydro-testing operations cannot cease midway, as it is imperative that the pipeline is maintained at pressure during the testing procedures. Section 5.7.1 discusses the details of the hydro-test procedure.
- Extenuating circumstances out of the control of the project (such as weather, industrial relations) result in delays to the pipeline program. When this occurs, notice would be given to the DoP and an outline of proposed work hours and scheduling would be provided.
- Works do not pose an audible disturbance to any residences. This is relevant in the more isolated sections of the pipeline, particularly the northern section. Noise impact offset criteria is defined in Chapter 11.
- The transportation of plant, equipment and pipe by oversized trucks outside of hours is required by authorities for safety reasons (eg to minimise potential impacts on traffic movements).
- It is required in an emergency to avoid injury or loss of life, property and/or to prevent environmental harm.
- An agreement is reached with local residents in order to reduce the duration of construction activities and/or manage other traffic, amenity or disturbance issues. An extensive community consultation program is defined in Chapter 11 as further work during the construction process.

The operations of the construction camps would occur over a 24 hour duration, for example catering and mechanical maintenance. These are ancillary operations that need to keep going over a 24 hour period, to sustain and service construction crews. Details relating to construction camps, including their location and siting, are discussed in Section 5.5.

Potential impacts relating to the proposed construction work hours have been considered under the human amenity impacts (refer to Chapter 11). Construction work hours are particularly related to noise and traffic impacts.

5.3.2 Equipment

Typical equipment used in pipeline construction includes:

- Bull dozers.
- Loaders.
- Graders.
- Side-boom tractors.
- Trucks.
- Padding machines.
- Excavators.
- Wheel ditching machines.
- Welding units.
- Crew vehicles.

Potential impacts associated with the operation of typical equipment, during construction, are discussed in Chapter 11 as part of noise and vibration impacts.

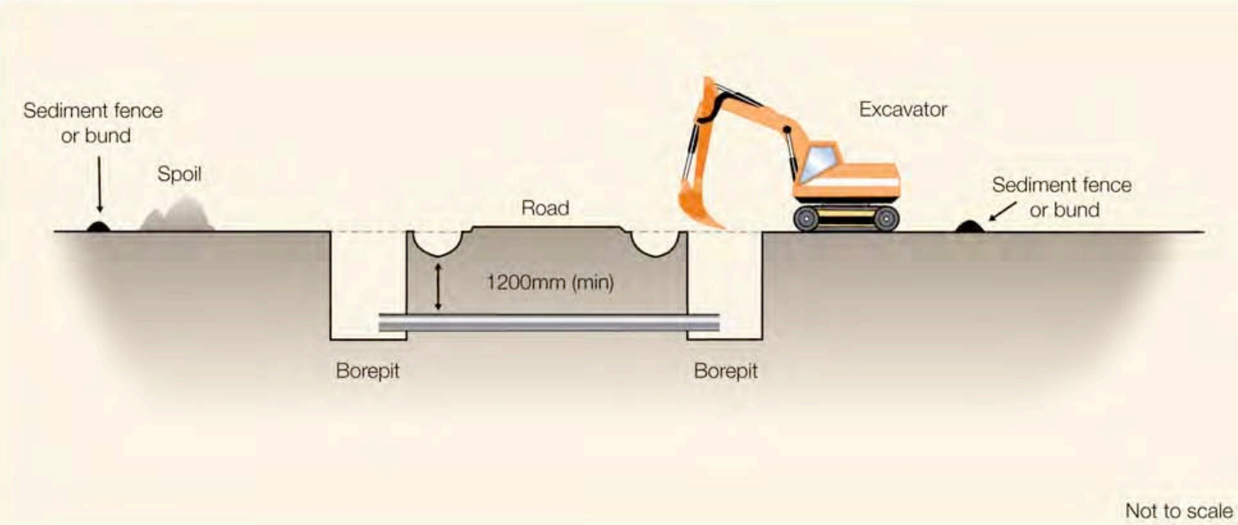
5.3.3 Infrastructure crossings

The crossing of any roads or rail lines would be carried out by a specialist crew, enabling the activity to generally be completed within one to two days. Some major crossings may take longer than two days to complete due to specific site characteristics. At no time would a major road be permanently impassable, as traffic management measures would be implemented. All rail and major sealed road crossings would be bored or HDD and there would be no interruption to rail traffic although some reduction in speed may be required. This would be negotiated with the relevant infrastructure service authority prior to commencement of a specific crossing. Refer to Chapter 6 for the stakeholder engagement strategy and Chapter 16 for details relating to potential infrastructure impacts.

Bore process

Boring would occur at railway crossings as well as major roads that cannot be open cut due to size or traffic conditions and where HDD is not practical. Bore works would include excavation of a bore pit on both sides of the crossing (refer to Figure 5.3). Adequate workspace would be required on both sides of the crossing location to accommodate the bore pit and installation equipment, (workspace area of approximately 30m by 60m would be needed), reaming of a hole underneath the road or railway, pushing or pulling the pipeline through the hole and tying into the pipeline sections. No disturbance to the road or rail surface would occur. Traffic would not be significantly impacted, however there is potential for minor disturbances due to moving of heavy equipment in and out of the area.

Figure 5.3 Bore process



5.3.4 Survey and fencing

At the start of the construction phase surveyors are sent into the field to mark the pipe centreline and the width of the ROW.

Fencing crews are also mobilised to set up temporary gates and fences along the route to allow for construction crew movement and protection of livestock. Gates are installed where fence lines are required to be breached.

5.3.5 Temporary facilities

A range of temporary facilities would be required during pipeline construction. These include work areas for equipment and pipe delivery and storage and camp sites. Occasionally borrow pits, to source additional fill material, may be required. Although the use of padding machines, which sift the subsoil to produce fine bedding material, has reduced the need for this in modern pipeline construction.

The location of the temporary facilities would be based on logistical requirements, the objectives for the pipeline route selection, the *APIA Code of Environmental Practice*, as well as the ability to negotiate with potentially affected landholders. Typical materials to be supplied to, and stored on, the ROW would include:

- Steel pipe.
- Diesel fuel.
- Consumables (eg welding rods, grinding discs).
- Two-part epoxy for coating of pipeline joins or tape wrap.
- Garnet for grit blasting welded joints.

Diesel fuel, when stored on site, would be contained in self-bunded tanks or in a tank within a plastic lined earthen bund. Epoxy materials would be supplied in drums and stored within a bunded area. Garnet would be supplied in bags (600kg), stored on pallets and covered to protect it from the weather. Safe work practices to prevent contamination events during construction are discussed in Section 17.2.

5.3.6 Clearing and grade

Clear and grade is carried out to provide a safe construction ROW for vehicular movement, trenching and other construction activities. An impact width of approximately 30m is generally required to enable construction operations to be safely and efficiently carried out, as well as to ensure adequate soil segregation. This impact width can be narrowed in ecologically sensitive areas to reduce impacts. It may also be increased when adjacent to watercourses, to provide additional room for stockpiling brush and soil outside of the watercourse for crossing activities where HDD is not used. Where HDD crossings are used, the river impacts are generally reduced. At creek crossings, sediment fences (eg geofabric attached to wooden stakes or star pickets) are installed around the toe of the topsoil stockpiles to prevent soil loss and sedimentation impacts within the watercourse.

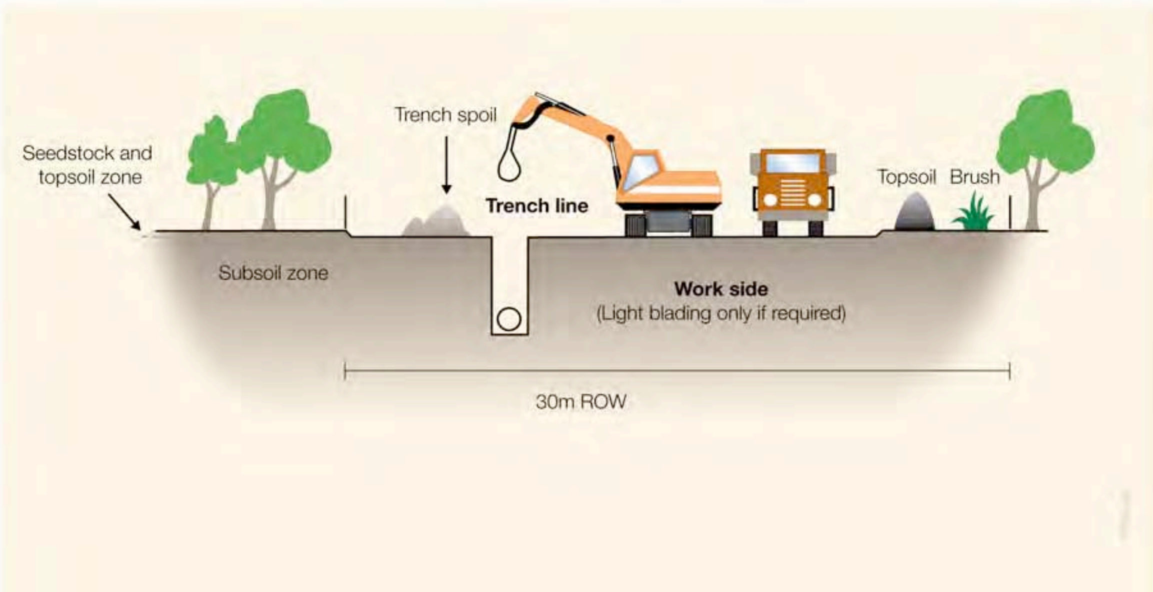
The ROW is cleared of heavy vegetation however, root stock is left in the ground where practicable to stabilise the area and reduce erosion. In scrubby areas the vegetation is stockpiled for respreading as part of the restoration process. Breaks are left in stockpiled vegetation to allow continued access to stock, fence lines, tracks and drainage lines. Large mature trees are preserved where practicable. The ROW is levelled to the required gradient using graders, backhoes and bulldozers. Topsoil is removed and stockpiled separately for re-use during reinstatement.

Chapters 9 and 15 provide details regarding potential impacts associated with clearing of vegetation and watercourse crossings, whilst Section 17.3 contains information regarding the management of geology and soils.

5.3.7 Trenching and blasting

A wheel trencher, rock saw or excavator is used to dig the trench in which the pipe would lie. The distance covered per day by trenching is dependent on terrain, rock/soil type, trench depth, equipment availability and weather conditions but typically on proposals of this nature a production rate of 3–4km/day is achieved in areas of soil substrate. The minimal practicable distance of trench is left open, depending on the land use, however up to 70km may be required in exceptional cases. This is due to the continuous production line process of pipeline construction where a sequence of activities immediately follow trenching, earlier parts of the trench will be backfilled while new parts of the trench are being excavated. Therefore, it is unlikely that any particular part of the trench is left open for a long period of time.

Figure 5.4 Typical ROW layout



Breaks in the trench are left to facilitate stock and wildlife crossing, agricultural vehicle movements, and at fences and drainage lines. In addition, methods to prevent fauna entrapment (eg trench breakers, ramped ends of trench, fauna ladders) are implemented. These methods ensure that fauna egress points in the trench are no more than 500m apart. Potential impacts upon fauna and proposed management measures are discussed in Chapter 9.

Typical trenching methods would be used for the majority of the route

In hard rock terrain where the use of wheel trenchers, rock saws or excavators is not feasible, controlled blasting may be used. Should blasting be required, a blasting operation procedure would be prepared detailing the proposed method of blasting, including safety, drill pattern, charges, explosives, detonation methods and debris control, prior to commencement. Prior notice would be given to all affected landholders, construction crew and other potentially affected parties. An assessment of potential impacts and management measures associated with the blasting operations is provided in Chapter 11.

5.3.8 Stringing and bending

Stringing is the term used to describe the laying out of the pipe in preparation for welding. Pipe is generally transported to site on trucks in 18m lengths. The pipe is laid out adjacent to the trench and held off the ground on skids that protect the pipe coating from damage. Prior to welding the pipes are bent to match the required vertical and/or horizontal profile.

Pipeline stringing

5.3.9 Welding inspection and coating

Once the pipe is strung, a line-up crew positions the pipe using side-boom tractors and internal line-up clamps. Specialised construction crews undertake the welding phase of the project. Pipes are typically welded into strings of up to 1.5km in length.

Each weld is subjected to a 100 per cent non-destructive test (NDT) inspection to check for compliance to specification, thus ensuring the integrity of each weld. This is typically carried out immediately after welding so that any defects in the weld can be repaired whilst the welding crews are still in the general vicinity.

Welding sections of pipe together

Following welding and inspection, the pipe is cleaned by grit blasting and an external coating is applied.

Grit blasting

Coating a pipe weld

5.3.10 Lowering in and backfilling

The trench is prepared as necessary to protect the pipe. This may include placing padding or supports (eg sandbags or Styrofoam blocks) in the bottom of the trench.

The pipe is first lifted off the skids and is then inspected and tested for defects, the pipe is then lowered into the trench using side-boom tractors.

Part A

Blocks, known as trench breakers, may be installed in the trench prior to backfilling to control water movement along the trench. Trench breakers are commonly installed in areas such as adjacent to watercourses, on steep slopes or where drainage patterns change.

The trench is then backfilled with screened trench spoil, which would sift around the pipe providing a stone free covering.

The remaining subsoil is then placed in the trench in layers (typically two layers) with compaction between each layer.

Using side-boom tractors to lower in the pipe

5.3.11 Acid sulphate soils trenching

Acid sulphate soils (ASS) contain iron sulphides and are located in low-lying, coastal areas, which are also often waterlogged. When exposed to air (such as being excavated for pipeline construction), the soils may oxidise and produce sulphuric acid, potentially releasing toxic quantities of iron, aluminium and other heavy metals into the environment if not managed.

ASS would primarily be a concern in the Maitland and Newcastle regions. Section 17.3 contains details of the soil characteristics of the regions and relevant mapping. Zones identified as being acid producing would be managed to avoid drying/oxidising the excavated material.

For example, pipe would be strung along the ROW and welded prior to excavating the trench in sensitive areas. The subsequent trench opening, pipe placement and closing time would then be limited to less than 12 hours in order to minimise the exposure time of the acid generating soils to oxygen and limit any associated acidification of drainage waters.

Trenching would occur over a shorter distance than normal in these areas to allow for reduced soil exposure time to air. Lime would also be stored on site for use in neutralising sulphuric acidification, if necessary.

Alternatively, HDD would be used to install the pipe in sections to avoid damage to sensitive/unstable areas.

A detailed acid sulphate management plan would be implemented as part of the Construction Environmental Management Plan (CEMP).

5.3.12 Watercourse crossings

Several methods can be used at watercourse crossings depending upon the size and nature of the watercourse flow regime and the quality of the riparian vegetation. In addition to pipe laying, temporary vehicle crossings may also be constructed to facilitate the movement of construction vehicles over watercourses.

Refer to Chapter 15 for a detailed description of high, medium and low significance relating to the environmental assessment of surface water crossings.

Watercourse crossing methods are described in detail in the following sections.

Standard open cut

The majority of watercourse crossings are expected to be constructed using standard open cut (trenching) construction. This technique is most suited to dry or low flow conditions. The banks of watercourses will be graded to enable a suitable slope for trench excavators. Watercourse bed and bank material and trench spoil are stockpiled separately. The pipe may be concrete coated or have river weights attached (refer to photo below) at watercourse crossings to protect the external coating and to prevent the pipe from 'floating' once in place. Pipe string welding and concrete coating generally occur prior to placement of the pipe in the trench. Tie-in points are located on high ground well away from any water flow.

Adding concrete weights at a watercourse crossing

Flow diversion

Flow diversion is a modification to the standard open cut method and is employed where higher water volumes and flows are present (typically up to 1,000 litres per second). The technique involves damming the watercourse and transferring the water from upstream to downstream around the work site.

Conditions that may influence the decision to employ flow diversion techniques include:

- Technical constraints limiting the ability to construct a suitable trench.
- Site safety and working conditions.
- Potential adverse impacts to water quality (principally as a result of increased sediment load), which may affect downstream users or ecosystems.

The key steps for a typical flow diversion crossing are:

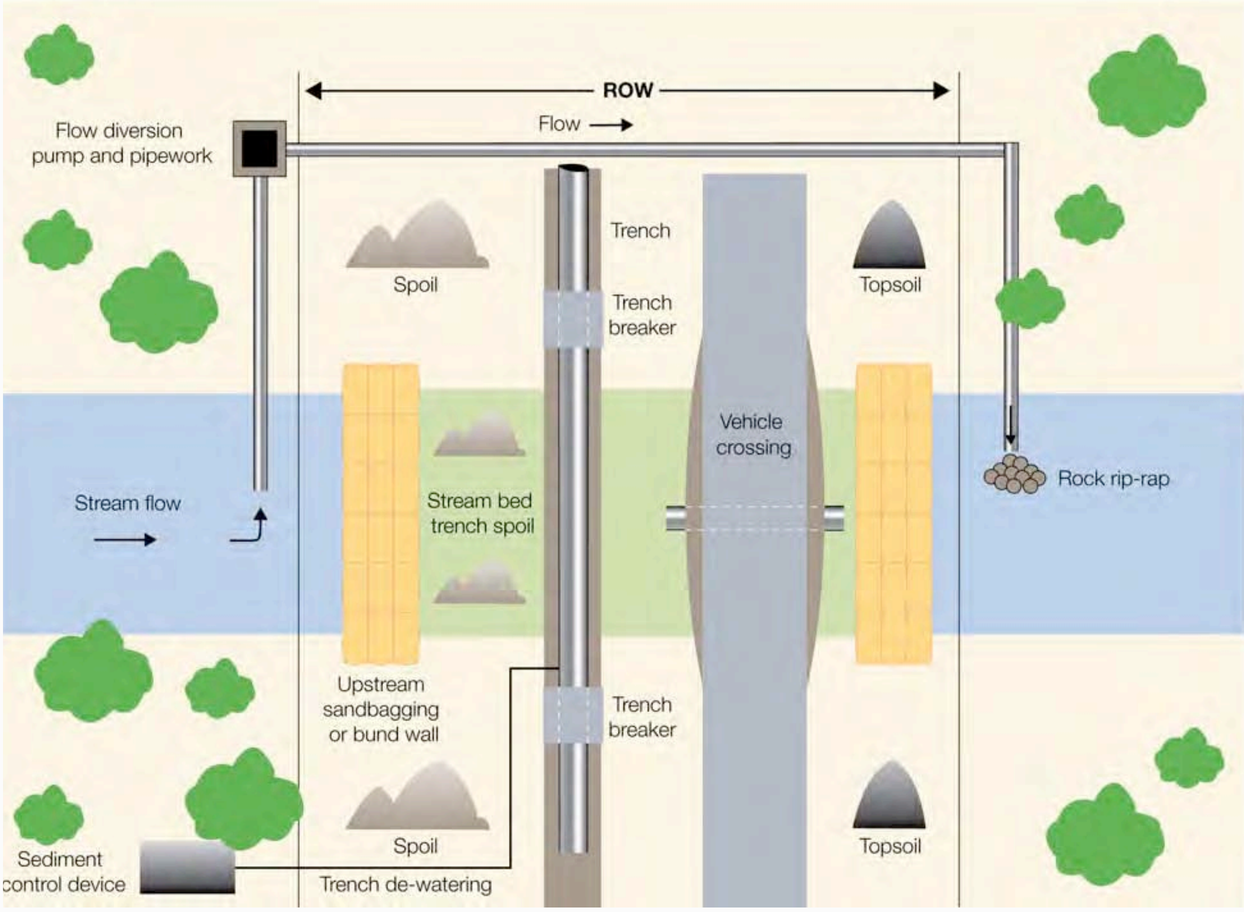
- Construction of a dam wall using plastic lined sandbags (or similar) to prevent the flow of water into the work area.
- Installation of a method of transferring the water from upstream to downstream (eg pump or flume).
- Installation of a pump to dewater the trench. Water from the trench is likely to be highly turbid and would not be discharged directly into the watercourse. It would be discharged through a filter system into the watercourse or discharged to stable ground away from the watercourse.
- Digging the trench and stockpiling the trench spoil above the bank in a bunded area ensuring that bed and bank materials are stockpiled separately.
- Installation of pre-welded pipe in the trench and return spoil material to the trench. Rock protection may be installed over the trench line in the stream bed to prevent potential scouring during flood conditions.
- Reinstatement of the banks to as near as practicable to their original profile. Where required geofabric (eg jute matting) may be used to hold soil in place. Such materials aid in bank stabilisation whilst being permeable to water and permitting plant growth.
- Reinstatement of vegetation as required. This usually involves seeding initially with sterile grasses (eg millet or rye corn) to facilitate revegetation and stabilisation of watercourse banks and permitting local vegetation to re-establish across the area.

Methods of transferring the water from upstream to downstream include pumping the flow around work areas, installing a flume or constructing a coffer dam.

Dam and pump

The dam and pump method would generally be utilised for minor to intermediate sized water bodies. A dam would be installed upstream of the crossing and the water would be pumped around the crossing location. Once the excavation and backfill is complete, the dam would be removed and flow would resume as normal.

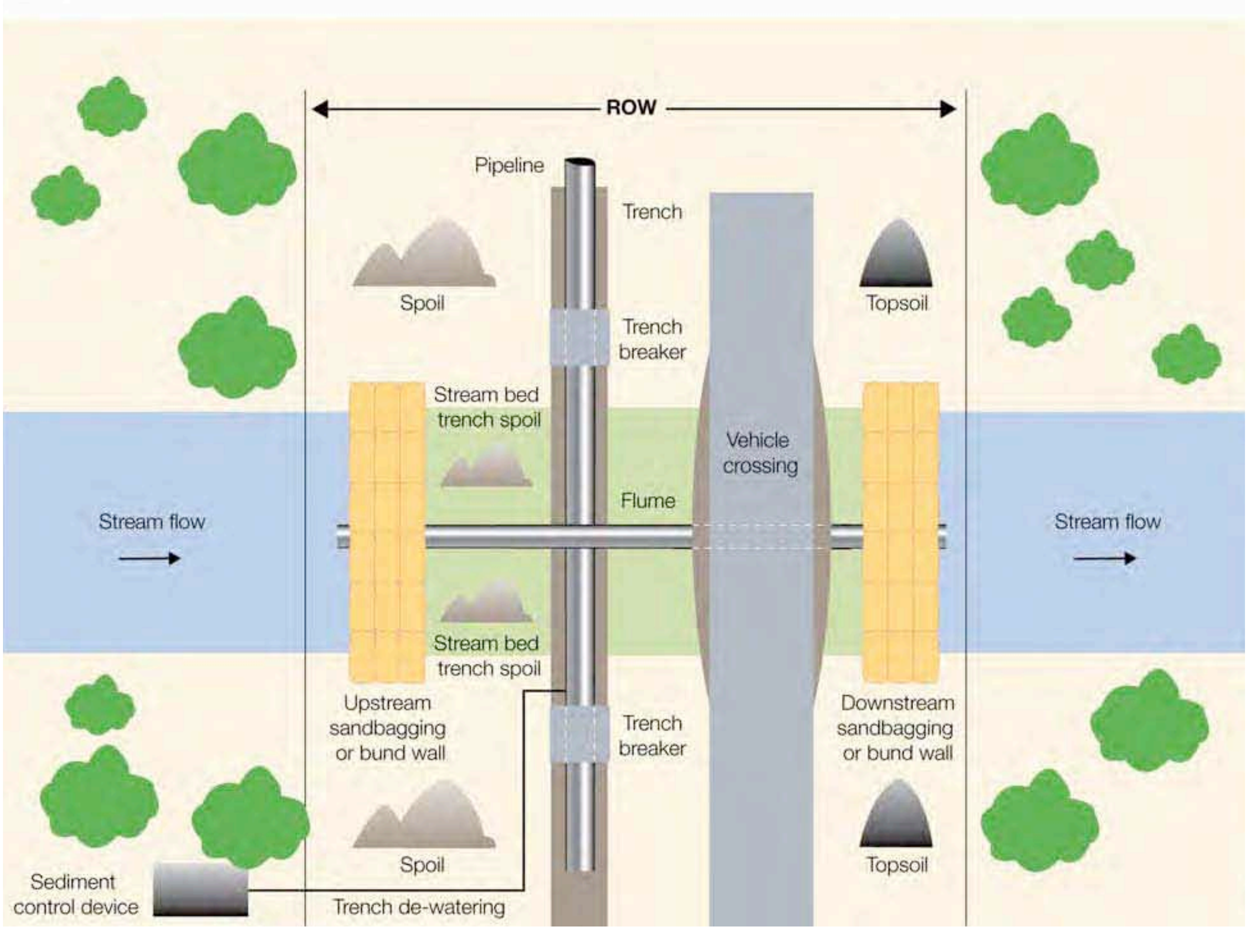
Figure 5.5 Dam and pump process



Flume

This method is similar to the dam and pump method but does not require a pump. Instead, the crossing is sealed off at both the upstream and downstream sides, and the water flow is diverted around the crossing location through a flume, or pipe. Flume method may be used when fisheries are in the area.

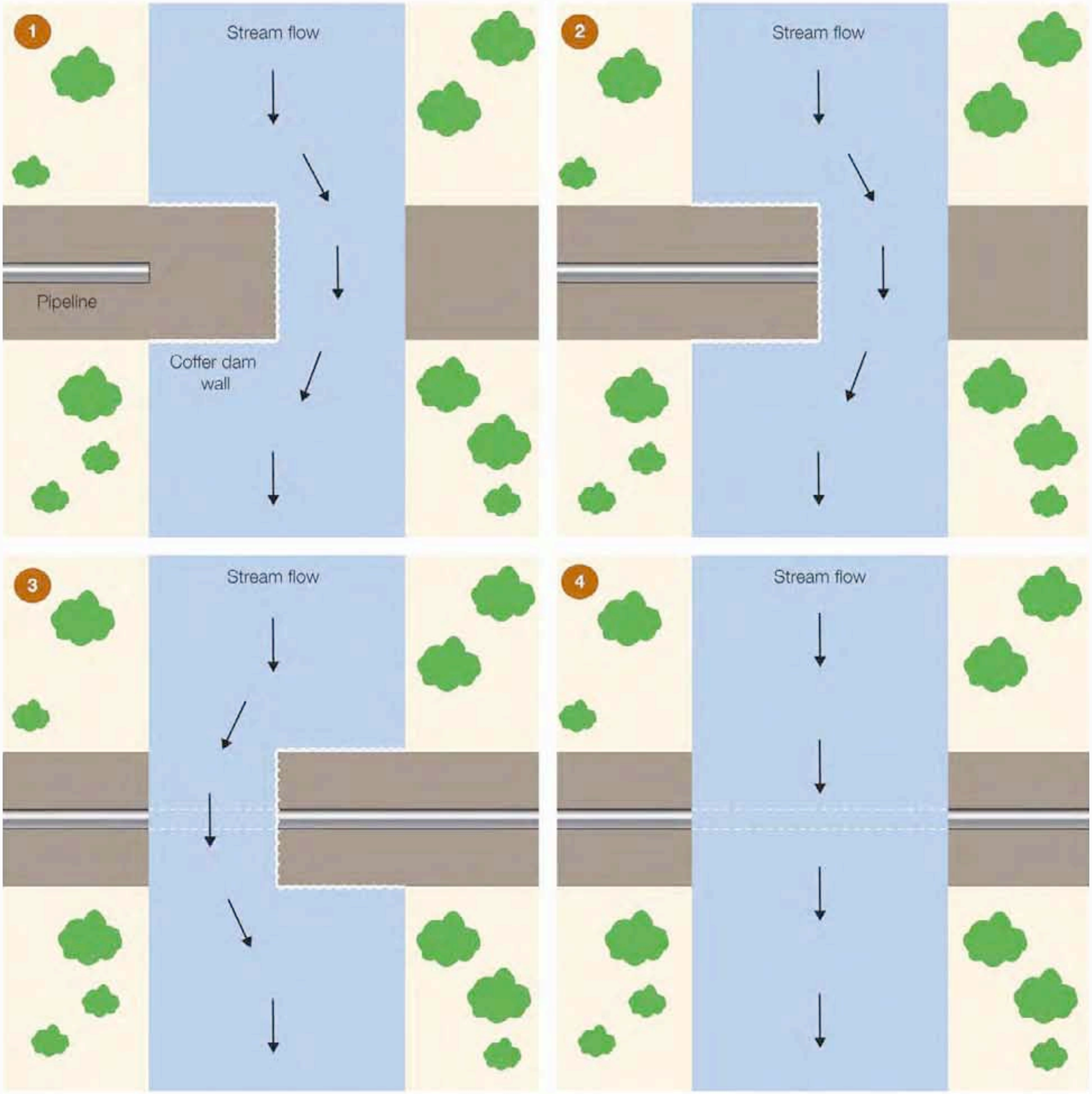
Figure 5.6 Flume process



Coffer dam

The coffer dam method would generally be utilised for intermediate sized water bodies. A partial dam would be installed on one side only of the crossing and the water would be deviated around the partial coffer dam location. Once the excavation, pipe installation, and backfill are completed, the dam would be removed and another coffer dam constructed on the other side of the river and the process repeated. After both sides are completed the second dam is removed and the flow is allowed to resume as normal.

Figure 5.7 Coffer dam process



HDD

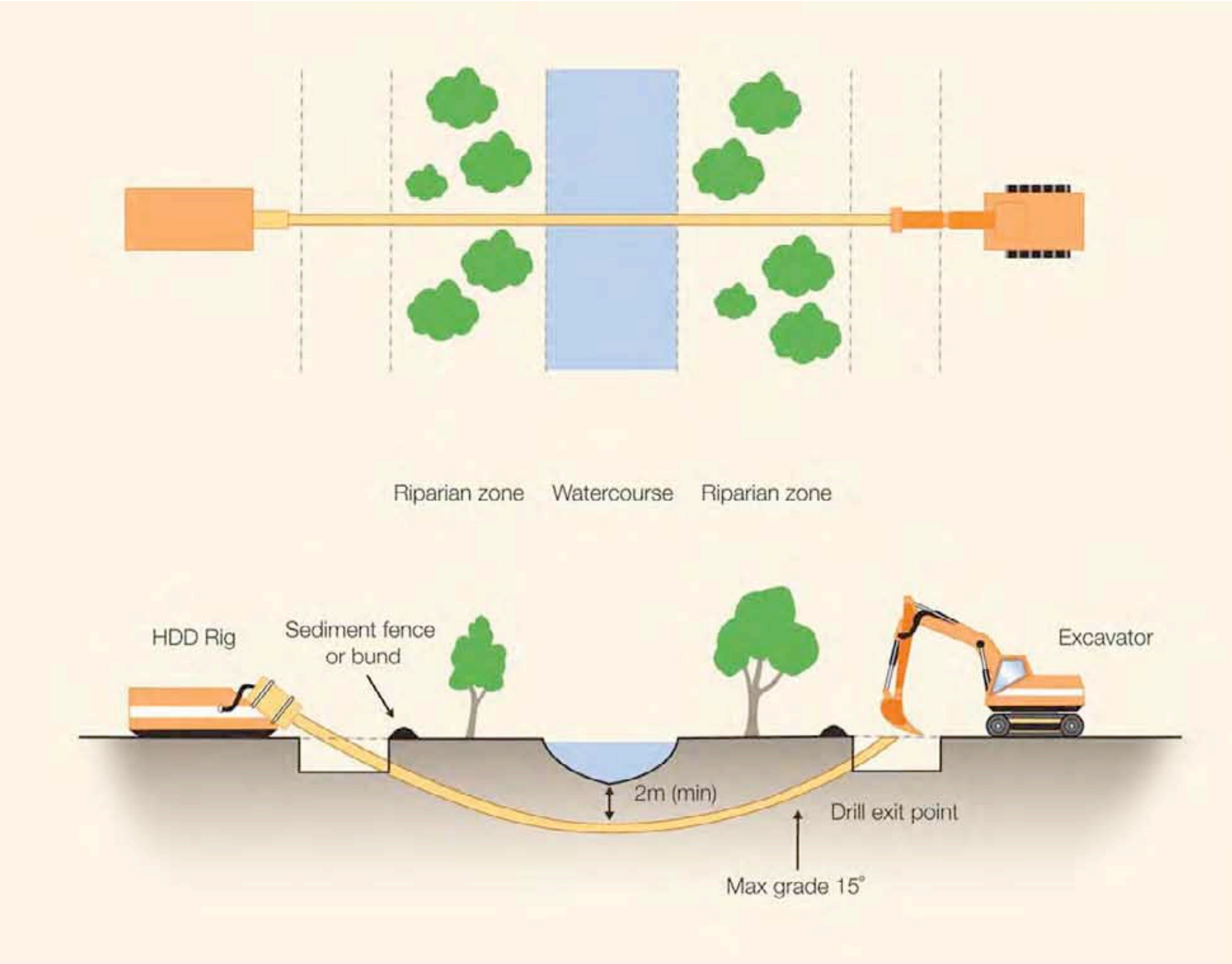
HDD would be used at large road or watercourse crossings where geotechnical conditions are suitable to cross large rivers with silt, gravel or rock bed. HDDs would generally be used when standard crossing methods are impractical. Single HDD methods can be used for crossings up to 2km or longer in length, dependent on terrain. HDD is proposed to be used for the lower Hunter River and other active or high flood flow river crossings. The feasibility of using HDD is limited by site conditions such as soil stability, slope, access, available workspace and nature of subsurface rock.

The installation of the pipeline by HDD involves drilling a hole at a shallow angle beneath the surface through which the pipe is threaded. Drilling is conducted by a specially designed drill rig and operated by a specialist contractor. A variety of associated equipment and infrastructure is required. To accommodate the necessary equipment on both the drill entrance and exit sides, the work area usually exceeds the standard ROW width, typically requiring a width of about 50m. A nearby source of water would also be necessary for drilling mud and hydraulics.

The HDD process would use large volumes of slurry during drilling. The slurry is pumped into the hole and is circulated back to the surface where it would be contained in a pit or tank roughly $15m^3$. The slurry would be recycled throughout the drilling process and would be disposed of once the HDD is completed. Waste management of drilling slurry is discussed in Section 17.1.

Although directional drilling may reduce impacts to the bed and banks of watercourses, the technique introduces additional environmental considerations. These include drill site sediment control, drill mud (water based bentonite) management, potential for drill mud seepage through alluvial materials, waste management and clearing of land for the pipe string. Access for vehicles and equipment around the watercourse is required resulting in the additional use, or creation of, access tracks. To address these issues, site-specific management procedures would be prepared prior to drilling.

Figure 5.8 Typical horizontal directional drill process



Horizontal directional drilling

Part A

5.3.13 Weed management

Weed management for the life of the proposal is of critical importance to the proponent and control techniques would be implemented at all phases of the proposal to cover any personnel traveling in the region. Control techniques include the identification and avoidance of infested areas where practicable, mapping of infested areas and washdown points and regular washdown of vehicles.

Prior to construction, access routes would be identified and, if necessary, a program of pre-spraying would be initiated. All vehicles and equipment would be clean on arrival at the ROW and would be required to adhere to the approved access routes and the ROW.

During the rehabilitation stage, selective poisoning or spraying typically to eliminate any weed regrowth or propagation from disturbed seed in the soil would be implemented.

Weed management measures would be developed and incorporated into the construction environmental management plan (CEMP) and all personnel entering the Study Area would be required to conform to the management measures developed. Refer to Chapter 9 for management and mitigation measures during construction and operation with regards to specific weed species, including noxious weeds.

Weed management measures would be identified in detail prior to construction for a particular parcel of land. The landholder would be involved in this process to ensure that the most appropriate measures are implemented with regard to the particular land use in that area. This would be undertaken in conjunction with the land use assessment process as described in Chapter 13. Specific management measures would be implemented in areas where, for example, Genetically Modified Organism (GMO) authorised cropping is being undertaken.

5.3.14 CEMP

Part B of this EA has outlined proposed mitigation and management measures during construction to manage potential impacts of environmental issues. Chapter 18 provides a summary of those areas that have been identified from the assessment as requiring further (targeted) field investigation due to the potential sensitivity of the environment as concluded from available desktop information.

A CEMP would be developed in consultation with DECC, DPI, and Department of Water and Energy (DWE) to manage environmental issues assessed and implement identified mitigation measures where required. This would include those mitigation and management measures presented in this EA and site specific mitigation measures, pending the outcomes from the field investigations.

The CEMP would be structured as follows:

- Introduction, including purpose of the document, scope of works and document control.
- Responsibilities, including cultural heritage matters.
- Training procedures.
- Auditing procedures.
- Incident management.
- Environmental management plans. These plans would review environmental values, potential impacts, protection objectives, control measures and approval conditions. At this stage, it is envisaged that the following environmental management plans would be developed, specific to gas pipeline developments:
  - Access and worksite preparation.
  - Camp site management.
  - Clear and grade.
  - Trenching.
  - HDDs.
  - Pipe stringing and bending.
  - Welding.
  - Laying in and backfilling.
  - Hydro-testing.
  - Reinstatement.
  - Cultural heritage management.
  - Weed management.
  - Waste management.
  - Hazardous materials management.

The CEMP would be focussed on the management of construction activities as they pertain to pipelines. This is consistent with the intent and objectives of *APIA Code of Environmental Practice*. Environmental issues that are assessed in this EA (refer to Part B) would be addressed in relation to the relevant construction activity. This is relevant for environmental impacts or incidences associated with:

- Noise and vibration.
- Fauna and flora.
- Dust.
- Soils – including ASS and erosion potential.
- Water.

- Spill response.
- Contamination.
- Waste management.
- Hydro-test water.

A draft outline of a CEMP is included in Appendix B.

5.4 Construction staging

It is anticipated that two pipeline construction spreads would be simultaneously mobilised for construction over the total length of the pipeline. A spread would be used in the more populous southern 150km length of the pipeline in NSW. The other spread(s) would be used to construct the pipeline north of the Liverpool Range, including Queensland. Additional small teams would be required for road and rail crossings and areas involving specialised construction techniques, including HDD, blasting and aboveground facility installation.

Each crew works at the rate of about 3–4km per day depending on the terrain (eg if there are more trees or the ground is very rocky progress may be slower). To enable the crews to work safely and efficiently there is often a delay between the arrival dates of each crew. Typically it would take up to four months for all the crews to pass through an area and complete their tasks. During this time there would be interruptions to some land uses (eg no crop growing or limited grazing over the ROW) and this would be negotiated with the landowner. Potential impacts relating to land use are further discussed in Chapter 13.

5.5 Construction workforce and accommodation

5.5.1 Construction workforce

It is anticipated that up to 600 direct jobs would be created during construction. Local contractors and service companies would be involved with the construction phase of the pipeline and associated facilities where practicable. However, some aspects of the construction process (eg welding, specialist crossing techniques, inspection and testing) require specialist pipeline/technical expertise, which would not be available in some local areas.

5.5.2 Construction camps

Due to the size of the construction workforce and the lack of available accommodation in rural areas, the construction workforce would most likely be housed in self-sufficient construction camps. It is expected that each spread would utilise one construction camp during the construction period.

Camps are normally located to keep travel distances to the work area to a maximum of 70km. At this stage, it is anticipated that two construction spreads would be in operation. Construction spreads in NSW would occur north and south of the Liverpool Ranges.

The temporary camp facilities would typically be air-conditioned demountable style units including:

- Accommodation blocks containing up to six rooms with shared ensuites (ie three bathrooms per block). The ensuites would contain a toilet and shower with hand basins being provided in each room. Rooms are typically equipped with a bed, wardrobe, table and small refrigerator.
- Central ablution unit containing toilets and laundry facilities for use by camp occupants.

- Messing units, which include cooking and eating facilities and a wet mess with recreation lounge.
- Offices.
- Training/meeting room.
- Equipped recreational room.
- First aid room.
- Workshop for maintenance of vehicles and equipment.

Typically pipeline construction crews work 28 days on and nine days off. Specialist contractors who travel from around Australia would work on a fly-in fly-out basis. Buses would be used to transport workers to and from the nearest airport at the start and end of each work cycle. Camps are normally relocated during the scheduled breaks to minimise any local inconvenience or disruption to work flow.

Camp facilities are designed to comply with all the appropriated health and hygiene requirements, and are completely self contained, portable facilities with their own power supplies, refrigeration and effluent disposal. They can be transported by road, established on a graded site and removed in a short time, leaving the site restored to its original condition.

Pets are banned from all pipeline construction activities to ensure that no pest species are introduced.

Food wastes would be kept covered or buried to prevent the introduction or attraction of vermin and flies.

Camp sites are typically located at a distance from the ROW thus minimising any noise and dust impacts on workers accommodation. All units, including all sleeping areas, would be air-conditioned to improve the amenity to workers. Where required, typical dust suppression (eg a water truck) would also be employed around the camp site to reduce dust impacts. Pipeline construction is typically carried out on a single approximately 12 hour shift with only limited personnel working at night (eg camp staff, vehicle and equipment fueling and maintenance crews). Locating camp sites at a sufficient distance from the ROW also ensures that these personnel are not disturbed whilst sleeping during the day.

At this stage it is not anticipated that any night construction work would be required. Should night work be required, appropriate measures would be taken to minimise disruptions to landowners and other stakeholders.

Table 5.5 Criteria for locating construction camps

Location criteria	
Environmental	
More than 100m from a waterway	Yes
Area of low ecological and heritage conservation significance	Yes
No substantial clearing of native vegetation required	Yes
Distance from dwellings or other sensitive receivers	500m
Engineering	
Easy and safe access to road network	Yes
Relatively level ground area required	4ha
Access to grid power	Not required

Location criteria	
Other	
Distance from ROW	500m
Maximum distance to work area	70km

5.6 Other activities during construction

5.6.1 Creation of pipeline easement and acquisition

In order for a pipeline to be constructed and operated, a pipeline licence under the *Pipelines Act 1967* is required. The Act also requires the proponent to obtain an interest in all the land comprising the pipeline route. This interest is normally in the form of a negotiated easement over the affected land.

Generally, the required easement width for the QHGP would be 30m. In addition to the general ROW, temporary work areas and truck turn around areas, up to 50m in width, would be required. These additional areas would be located outside culturally or environmentally sensitive areas.

The proponent is and will be actively negotiating with landholders along the ROW to agree to compensation and terms and conditions of individual consent agreements.

Where landholders do not enter into easement agreements, the proponent would need to rely on government support to undertake a compulsory acquisition process for those parcels of land. This process would allow compensation to be properly determined by a third party valuer if agreement between the landholder and the proponent cannot be reached.

5.6.2 Property and access arrangements

During construction, access tracks would be required to areas such as the pipeline ROW, facility sites and camp sites. Existing roads, tracks and disturbed areas would be utilised as far as practicable to minimise disturbance to the surrounding areas. The selection of access track routes would be based on consultation with all relevant landholders and regulatory authorities. New access tracks would avoid environmentally sensitive areas and shall be scheduled to minimise disturbance to landholders. Access tracks would be reinstated in accordance with landowner requirements. An assessment of the potential land use impacts from the construction and operation of the proposed pipeline is provided in Chapter 13.

5.6.3 Utilities

Gas

No gas would be required during construction. Some gas may be used to purge the pipeline after it is constructed.

Electricity

Construction power would be by on site generators.

Telecommunications

During the construction phase of the proposal, temporary communications systems would be implemented including fixed station satellite dishes at the camps and the use of mobile or satellite telephones for selected personnel.

Construction vehicles would be fitted with radios (UHF or VHF) for communication between vehicles. These radios would require the installation of temporary repeater towers at intervals along the route. Since the repeater towers would be located to meet transmission requirements, the locations would not be determined until after the construction contractor has been appointed. Whilst being governed by the need to pick up the signals, site selection would also be carried out in conformity with the route selection criteria (ie avoidance of environmentally and culturally sensitive locations). The repeater towers would be guyed towers, typically located on elevated positions to increase transmission range. The repeater stations would be powered by local solar panels. Upon completion of the construction phase, these temporary towers would be removed and the sites rehabilitated.

Communications for the ongoing operations phase would be provided via fixed satellite dishes or via existing communication networks at the pipeline facility sites (ie MLVs and scraper stations). Operation personnel would have either a mobile telephone or vehicles fitted with telephones, or both.

Water

Raw water would be required for dust control and maintenance of the construction ROW and access tracks (quantity dependent on conditions), as well as for hydrostatic testing of the pipeline during construction. Potable water for domestic use would also be required during the construction phase.

Details on the use of water resources during construction and commissioning of the pipeline, particularly that relating to hydrostatic test water and dust suppression, are discussed in Section 5.7.1.

Sewerage

The construction camp facilities would be self-sufficient although there may be a need to pump out the systems and dispose of the effluent to existing sewerage systems in the region.

Waste management relating to waste effluent is discussed in Section 17.1.

5.6.4 Traffic management during construction

The key transport issues for the proposal are associated with the construction phase when plant, equipment, materials (including pipe), camp facilities and personnel are required to be moved to and from the work sites.

Pipeline construction typically involves initial delivery of construction plant and equipment (eg graders, excavators, bulldozers and welding units) and camp facilities and then daily movements associated with construction workers and pipe deliveries.

Traffic issues, mitigation and management are addressed in Chapter 11.

Loading pipe from rail to trucks

Moving heavy plant equipment between sites

5.7 Commissioning activities

5.7.1 Hydrostatic testing

Once the pipeline has been installed in the trench it is subjected to a hydrostatic test to prove the integrity of the pipeline. Hydro-testing of the pipeline requires large single volumes of water to be pumped into the pipe in sections and pressurised to a level above the maximum allowable operating pressure. The pipe is divided into sections, which are capped with test manifolds, filled with water and pressurised to the specified test pressure and held for the required period.

The methodology for hydro-testing depends upon the quality and quantity of the water available. Generally, 50km of pipe would be tested at any one time, except in steep terrain where shorter sections would be used. The volume of water required for testing the entire pipeline would be approximately 30ML. In order to conserve the amount of water used, the test water would be recycled and re-used. Water loss for each test would be in the order of five per cent.

Hydro-testing procedures, including water sourcing and disposal, would be determined during the detailed design and construction phase. Water is normally sourced from existing water sources in the area such as dams or watercourses. Depending on the location of the source, the water would either be pumped directly from the watercourse to the pipeline via a temporary pipe or hose, or be hauled in by tankers.

Hydro-test water would not be discharged directly to natural water bodies. If appropriate and practicable, the discarded water would be supplied for beneficial use in consultation with landowners. Where water is not suitable, or it is not practicable, for beneficial use it would be disposed to land typically through a settling and filtration structure, with erosion and scour controls in place.

Disposal of hydro-test water has received much attention from regulatory authorities in recent years and during 2005 the CSIRO Manufacturing and Infrastructure Technology (CMIT) group conducted studies into the quality of hydro-test water. The study found that the impact of hydro-test water on the environment was a function of the initial water quality, nature of any additives, the rate of application, the site of application and the robustness of the receiving ecosystem.

Corrosion inhibiting chemicals, in the form of oxygen scavengers, may be added to the hydro-test water depending upon the quality of the available water and the length of time the water is required to be held in the pipe. The oxygen scavengers reduce the amount of oxygen available within the pipeline, thus reducing the potential for corrosion. The effects of oxygen scavengers within the test water can be treated though exposure to air (ie spraying of the water into the air).

The presence of certain bacteria, such as sulphate reducing bacteria (SRB) that are often found in soil, can induce bio-corrosion of the pipe walls. Elimination of suspended particles, scale and cleaning of the pipe by scrubbing and flushing is often sufficient to reduce the potential habitats and bacteria proliferation (CMIT, 2005). Biocides may occasionally, but very rarely, be added to the water to prevent the formation and growth of micro-organsims. If it is found necessary to use biocides, due to the quality of the available water and/or the duration that the water is required to be held in the pipe, then treatment and disposal would be in accordance with the recommendations made in the CMIT report (2005) on hydro-tests.

Any additives would be selected to minimise their potential to cause harm to the environment, whilst adequately protecting against corrosion in the pipeline.

Examples of typical oxygen scavengers and biocides used in the oil and gas industry are given in Table 5.6 and Table 5.7.

Table 5.6 Examples of common oxygen scavengers

Active ingredient	Example
Ammonium bisulphite	Baker Petrolite 3-514 OS
Sodium sulphite	Chemtreat 649L
Sodium bisulphite	
Sodium metabisulphite	MAXSO3™ Chemtreat 650 OS
Liquid carbonhydrazide	
Monoethanolamine	Cortron IRU-163

Source: CMIT, 2005

Table 5.7 Examples of biocides used in the oil and gas industry

Biocide	Active ingredient	Examples
iayoxal	Dialdehyde	
Organobromide	DBNPA (2,2 dibromo-3-nitrilopropionamide)	Dow™Antimicrobial 7287 Antimicrobial 8536
Polymeric biguanide	PHMB	Vantocil® IB
Quaternary phosphonium salt	THPS (tetrakis(hydroxymethyl)phosphonium sulphate)	Tollcide® PS71S Bactron AUK-550
Quaternary ammonium	Alkyldimethylbenzylammonium chloride	Synprolam™ 35DMBQC50 and 80 Barquat® OJ50 and OJ80 Arquad™ B-100
Thiocyanate	MBT	AMA®-410W AMA®-210
Combination package	Biguanide/oxygen scavenger/corrosion inhibitor	

Source: Chen and Chen 1997, Frayne 2001 cited in CMIT, 2005.

Hydro-testing of the pipeline is reviewed in the mitigation and management measures in Section 17.1

5.7.2 Clean up and reinstatement

Clean up and reinstatement measures are applied to the ROW, work areas, access tracks and camp sites in consultation with the relevant landholder. Generally, clean up and reinstatement involves removal of foreign material (eg construction material and waste), surface contouring, respreading topsoil, respreading vegetation and, where required, reseeding. Typically no plant matter is removed from the ROW, but rather it is respread over the ROW. The respreading of plant matter assists in both stabilising the ground and re-establishing local vegetation. Occasionally, it is necessary to dispose of the plant matter (eg heavy weed infestation) and this is done through burning off under controlled conditions. However, this is normally a last resort and would only be undertaken with the appropriate approvals from the local fire authority and during the appropriate season.

Typically, the landscape is reinstated to pre-existing contours and natural drainage lines restored and protected (if required). In certain cases, reinstatement is tailored to site-specific conditions in consultation with the landholder.

To promote vegetation regrowth and protect against the loss of topsoil, the ROW surface is normally lightly scarified prior to respreading of topsoil. Erosion and sedimentation controls would remain in place until sufficient groundcover is achieved through regeneration of vegetation.

Reinstatement is undertaken in accordance with the *APIA Code of Environmental Practice* to ensure that:

- Topsoil cover is re-established and all land and waterways disturbed by proposal activities are returned to a stable condition as soon as possible after construction.
- Land is returned as close as possible to its previous productivity.
- Stable landforms are re-established close to original topographic contours.
- Natural drainage patterns are reinstated.
- Erosion control measures (eg contour banks, filter strips) are installed in erosion prone areas.
- The environment is reinstated as near as possible to the condition of the surrounding area.

Reinstatement management measures have been further discussed in Chapter 9.

Installation of marker signs

Pipeline marker signs in accordance with *AS2885* would be installed to indicate the presence of the pipeline and to reduce the risk of inadvertent damage by third parties. Marker signs would be installed at:

- Both sides of road and rail crossings.
- Both sides of significant watercourse crossings.
- All fence lines.
- All utility crossings, except in the middle of cultivated areas.
- Significant bends, except in the middle of cultivated areas.
- All aboveground facilities.
- As otherwise required to be visible.

A typical marker sign which would be installed after construction

5.7.3 Commissioning

Instrumentation calibration

All instrumentation would be calibrated in accordance with appropriate Australian standards, industry guidelines and manufactures instructions.

Performance testing

All systems (eg shut down and start up) and all valves and equipment would be tested in accordance with Australian standards and industry guidelines to ensure that they are operating to the design specifications. Where any tests fall outside of the agreed acceptance criteria repair work or modifications would be carried out and the items would be retested.

Baseline intelligent pig run

An intelligent pig run, utilising either magnetic flux loss or ultrasonic methods, would be undertaken to:

- Confirm that there are no gouges, dents or other defects from the construction process.
- Provide a baseline for future pipeline integrity studies to be carried out.

Pipeline drying

The pipeline would be dried to an acceptable dew point standard so that initial gas is maintained to standard. This is done by running many scraper pigs and then foam pigs to push out and soak up remaining hydrostatic test water. These pigs are propelled using dry air to assist in the drying process.

Alternatively once the pipeline has been pigged so that free liquid water is removed a large vacuum unit may be attached to the pipe to remove any remaining liquid water and water vapour. This obviates the need for the purging step, as there is no other gas in the pipeline.

Pipeline purging

The pipeline may be purged of air prior to the introduction of gas to ensure safe entry of the gas. Typically this is done by introducing a slug of inert gas immediately prior to introducing the CSG directly into the pipeline to create an inert interface between the air and the gas. This allows the arrival of the gas/air interface at the downstream vent point to be readily detected.

Alternatively, the gas can be introduced directly into the pipeline under strictly controlled conditions. The volume of CSG that would be vented to the atmosphere would be limited to that necessary to ensure the gas/air interface has passed the vent points.

The purging method would be selected as part of the detailed planning for the commissioning program and would be subjected to safety and risk analysis as required.

Odorants would not be used in this pipeline.

5.8 Operational activities

Operational activities would be outlined within operational plans of management. Environmental aspects and issues relevant to the operational phase of the QHGP would be encapsulated within an Operation Environment Management Plan (OEMP). Chapter 18 describes the further management of environmental constraints, including the preparation of an OEMP.

5.8.1 Operating conditions and practices

General operations encompass routine operation and maintenance programs including ground and aerial patrols, repair of equipment, cleaning of the pipeline (pigging), monitoring for corrosion and remediation and tenure area maintenance including access roads. Aerial and/or ground inspections include detection of erosion, monitoring of reinstatement success, and detection and control of weed species. The pipeline would have a CP system, which would be regularly monitored.

All gas flows are metered with high accuracy metering. This information is continually checked against the volume of gas within the pipeline and any major imbalance immediately checked to confirm the integrity of the pipeline.

The likelihood of uncontrolled gas leakage or venting is extremely low due to both design and procedural controls associated with the pipeline. These measures are in place to greatly reduce the likelihood of third party interference causing rupture to the pipeline.

During normal operations, occasional venting of small quantities of gas may occur under controlled conditions at valve, scraper stations, in accordance with established operating procedures. The risk to public safety in these operations is very low, primarily because:

- The stations are typically located in isolated areas, away from the general public.
- The venting is conducted under controlled conditions and can be stopped if conditions become unfavourable (eg strong winds or storms).

- The nature of the gas, with a very high methane content, is extremely buoyant in air and disperses very quickly. This essentially eliminates the likelihood of a flammable atmosphere forming.
- Electrical equipment inside the compound, for areas where gas can escape, is rated for use in explosive atmospheres and therefore potential ignition sources are kept to a minimum.

If a leak were to occur, the following systems would be in place to minimise any risk to public safety:

- Balanced metering to detect discrepancies that may indicate a leak.
- Leaking sections are remotely isolated as soon as possible after the leak is detected.
- Pipeline personnel are deployed to control the leak and isolate the area.
- The pipeline can be depressurised safely through cold vents at pipeline facilities.
- If required, local landowners and emergency services are notified.

Hazards and risks associated with the pipeline are discussed further in Chapter 14.

5.8.2 Utilities

Gas

CSG from the pipeline would be utilised as the power source for some valve operators.

Electricity

Power for the scraper stations, MLV sites and CP system is likely to be solar. However, if mains power is available it may be considered as an alternative. Power for the meter stations would be less than 50kW and mains sourced.

Telecommunications

Communications for the ongoing operations phase would be provided via fixed satellite dishes, microwave, or by data cable at the pipeline facility sites (ie MLVs and scraper stations) and operations personnel would have either a mobile satellite telephone or vehicles fitted with satellite telephones, or both.

5.8.3 Maintenance of pipeline

Prevention of damage due to third party activity has been discussed as part of pipeline design principles.

Corrosion is prevented by the protective external coating and CP systems. The CP system is checked regularly to ensure that the protection voltages are within limits and to monitor any likely areas of corrosion activity. The CP system and external coating system work independently to protect the pipeline from corrosion. If corrosion is detected the relevant section of pipe may have additional CP applied or need to be excavated and remediation measures implemented.

A maintenance schedule would be created for the orderly undertaking of valve lubrication and maintenance, sign and sign post maintenance, painting of aboveground facilities and other necessary activities.

In the fifth year of operation, an intelligent pig run would be conducted. The results of this run would be used to determine if, and where, any remedial action is required. This would also be compared to the intelligent pig run carried out as part of commissioning, to determine the timing of the next intelligent pig run and if there is any rate of degradation of the pipe wall.

5.8.4 Maintenance of easement

Maintenance of the pipeline easement is carried out through a process of regular inspections and repairs.

Inspection

During the operational phase of the pipeline the permanent easement would be patrolled on a regular basis. This would be done as a part of the regular operation of the pipeline, as part of planned maintenance trips or as a dedicated route inspection trip. In addition to the regular inspection trips, specific inspections would be carried out after heavy rainfall or flash flooding. Experienced personnel using ground vehicles or aircraft, as appropriate, would do all inspections. Future use of Autonomous Unmanned Aircraft (AUF) is also being considered.

Inspection of the pipeline easement would target:

- Erosion.
- Encroachment.
- Potential injurious construction or other activity.
- Digging activities, such as:
  - Land levelling.
  - Table drain clearing.
  - Trenching/ploughing for utility installation.
- Drilling for fencing, foundations and soil testing.
- Water impoundment.
- Unauthorised access.
- Dumping of rubbish.
- Rate of revegetation (in early years).
- Vegetation dead spots (potential leakage).
- Missing or vandalised signage.
- Facility vandalism.
- Noxious and other weeds.
- Trench subsidence in early years of operation.
- Vegetation that would block emergency access.

Repairs

Potential conditions that would require repairs and, when evident, the appropriate remedial actions that would be taken are set out in Table 5.8.

Table 5.8 Likely repairs and remedial actions

Potential repair requirement	Remedial action summary
Erosion	After discussion and coordination with the landholder, the land would be regraded close to the original contour. Additional erosion control measures such as seeding for regrowth, run off control structures or rip rap at stream banks may be utilised if required.
Encroachment	The landholder would be contacted to stop the encroaching activity, remove any structures that have been built over the pipeline and restore the land to the original contour.
Potentially injurious construction or other activity (eg road construction over the pipeline)	The landholder or constructor would be told to immediately cease activity until measures have been taken to properly protect the pipeline.
Digging activities	The activity would be immediately stopped. The pipeline and easement would be marked. If digging must be done within the easement then a QHGP representative must be present. All digging within 500mm of the pipe must be done by hand. Any damage to the pipe must be repaired and would be at the expense of the damaging party.
Dumping of rubbish	Rubbish would be removed and disposed of in an appropriate manner. Efforts would be made to limit access to the area.
Rate of revegetation	Ecologists would be used to assess the rate of regrowth over the pipeline ROW for the first 18 months after the installation of the pipeline. Where the area is not revegetating at the same rate as the surrounding area measures such as reseeding and/or fertilisation would be implemented. Any reseeding or fertilisation would be carried out in accordance with the CEMP and in consultation with the relevant landholder. A drive line would need to be maintained free of trees to ensure no damage to the pipeline through root systems and to provide access for both regular inspections and emergency situations. Where trees are impinging on the drive line they may be removed by slashing or herbicide spraying on an as needed basis.
Vegetation dead spots (potential leakage)	Dead spots would be assessed using a gas sniffer to determine if hydrocarbon vapour is present. If vapour is present the area would be excavated to locate any potential leak. If a leak is located then the area would be repaired in accordance with company procedure and *AS2885*. The pipe would be recoated for corrosion protection, backfilled and the surface restored to the original contours. If there is no leakage the area would be backfilled and restored to the original contours.
Missing/vandalised signage	The sign and post (if required) would be replaced. The damaged sign and/or post would be removed and disposed of. If this is a persistent problem in certain locations more robust signage would be installed. If the problem still persists the issue would be referred to the local police authorities.
Facility vandalism	All aboveground facilities would be inside a security fence. Where vandalism occurs, repairs would be carried out and, if necessary, additional security measures would be considered and installed. All acts of vandalism that could pose a threat to the overall security of the pipeline would be reported to the police.

Potential repair requirement	Remedial action summary
Noxious weeds	Noxious weeds if present along the easement as a result of construction or operations/maintenance activities would be eliminated by cutting, spraying or removal as appropriate to the type of weed, the season, the size of the infestation and in consultation with the landholder.
Trench subsidence	In the first few years after construction, there may be subsidence along the ditch in certain soil types due to compaction of the backfill. Where trench subsidence occurs and the subsidence affects the local drainage pattern, the land use or causes erosion then the area would be backfilled and regraded to the surrounding contours. Local material would be used wherever practicable. If imported fill is required this would be sourced from suppliers who can provide certified weed free material.

6 Community and stakeholder consultation

6.1 Introduction

6.1.1 Context

As part of the previous environmental assessment prepared in 2006 (see Chapter 1 regarding the proposal history), consultation was undertaken with a range of stakeholders. With the commencement of a new EA, a revised Study Area and the involvement of a new project team, an entirely new consultation process was started for all stakeholders.

As such this chapter details the objectives, methods, extent and outcomes of consultation undertaken during the course of developing the current proposal. It does not discuss the outcomes of any previous consultation process. One of the challenges for the project team has been to manage the potential confusion that may have emerged through previous consultation in relation to the earlier QHGP proposal. Therefore, considerable effort has been applied to managing expectations and minimising confusion for stakeholders previously consulted.

6.1.2 Rationale

Throughout this chapter the term ‘stakeholder consultation’ is used to describe the overall process and approach to communicating with stakeholders, by providing information on the proposal and seeking feedback on key issues. Stakeholders for the proposal comprise a large and diverse range of groups and individuals who have differing needs, interests and responsibilities in relation to the proposal, including communities, individual landowners, government departments, statutory bodies, utilities, Aboriginal stakeholders and interest groups.

The stakeholder consultation process was designed to meet the consultation objectives set out in the DGRs for the proposal. An integrated and inclusive approach has been taken that aims to foster an open and transparent flow of information and feedback between the proponent and stakeholder groups.

The stakeholder consultation process commenced in August 2007 with the undertaking of a stakeholder scan to identify stakeholders, their key areas of interest and level of interest in the proposal and the preparation of a stakeholder engagement plan. Since that time, a number of information materials have been prepared for dissemination to stakeholders and meetings, presentations and consultation sessions have been held with landowners, local councils, Aboriginal stakeholders, infrastructure owners/operators and government authorities.

Feedback from stakeholders on the QHGP influences many aspects of the proposal including pipeline design, route alignment and the mitigation measures chosen. Section 6.4 provides a summary of how issues raised by stakeholders to date have contributed to shaping the proposal. A table detailing all of the issues raised during stakeholder consultation and identifying where these issues are addressed in the EA is located in Appendix C.

6.1.3 Objectives

The primary objective of the stakeholder consultation process was to meet or exceed the DGRs for consultation for the EA. These requirements are to:

- Undertake an appropriate and justified level of consultation with the following parties during the preparation of the EA:
  - Commonwealth Department of Environment and Heritage (now Department of the Environment, Water, Heritage and the Arts, DEWHA).
  - NSW DoP.
  - NSW DECC.
  - NSW DPI.
  - Relevant Catchment Management Authorities.
  - NSW DWE, Country Energy and Transgrid.
  - NSW Roads and Traffic Authority (RTA), State Rail Corporation and Australian Rail Track Corporation (ARTC).
  - NSW Department of Lands, relevant Landcare groups and relevant Rural Lands Protection Boards.
  - NSW Mine Subsidence Board.
  - Relevant local Aboriginal communities and Local Aboriginal Land Councils.
  - Local councils of Moree Plains, Narrabri, Gunnedah, Liverpool Plains, Upper Hunter, Muswellbrook, Singleton, Maitland, Port Stephens and Newcastle.
- Undertake appropriate consultation with the local community. The EA must clearly indicate issues raised by stakeholders during consultation, and how those matters have been addressed in the EA.

In addition to the consultation requirements stipulated by the DGRs, the stakeholder consultation process was designed to meet the following key objectives for the proposal:

- Provide stakeholders with accurate, consistent and accessible information regarding the proposal.
- Seek feedback from stakeholders on their needs and key issues in relation to the proposal.
- Engage with stakeholders and seek their input with respect to key issues and outcomes.
- Use a range of consultation methodologies to ensure all stakeholders have the opportunity to be involved in the consultation process.
- Demonstrate to stakeholders a commitment to developing and maintaining transparent and open channels of communication.

6.2 Methodology

The first step in the consultation process was undertaking a stakeholder scan to identify the various stakeholders involved in the proposal and provide a preliminary assessment of stakeholders' key issues and level of interest in the proposal. The stakeholder scan identified all of the stakeholders listed in the DGRs as well as:

- Individual landowners.
- Utilities.
- Elected representatives (federal, state and local).
- Community, environmental and interest groups.
- Industry, including potential customers.
- Media.

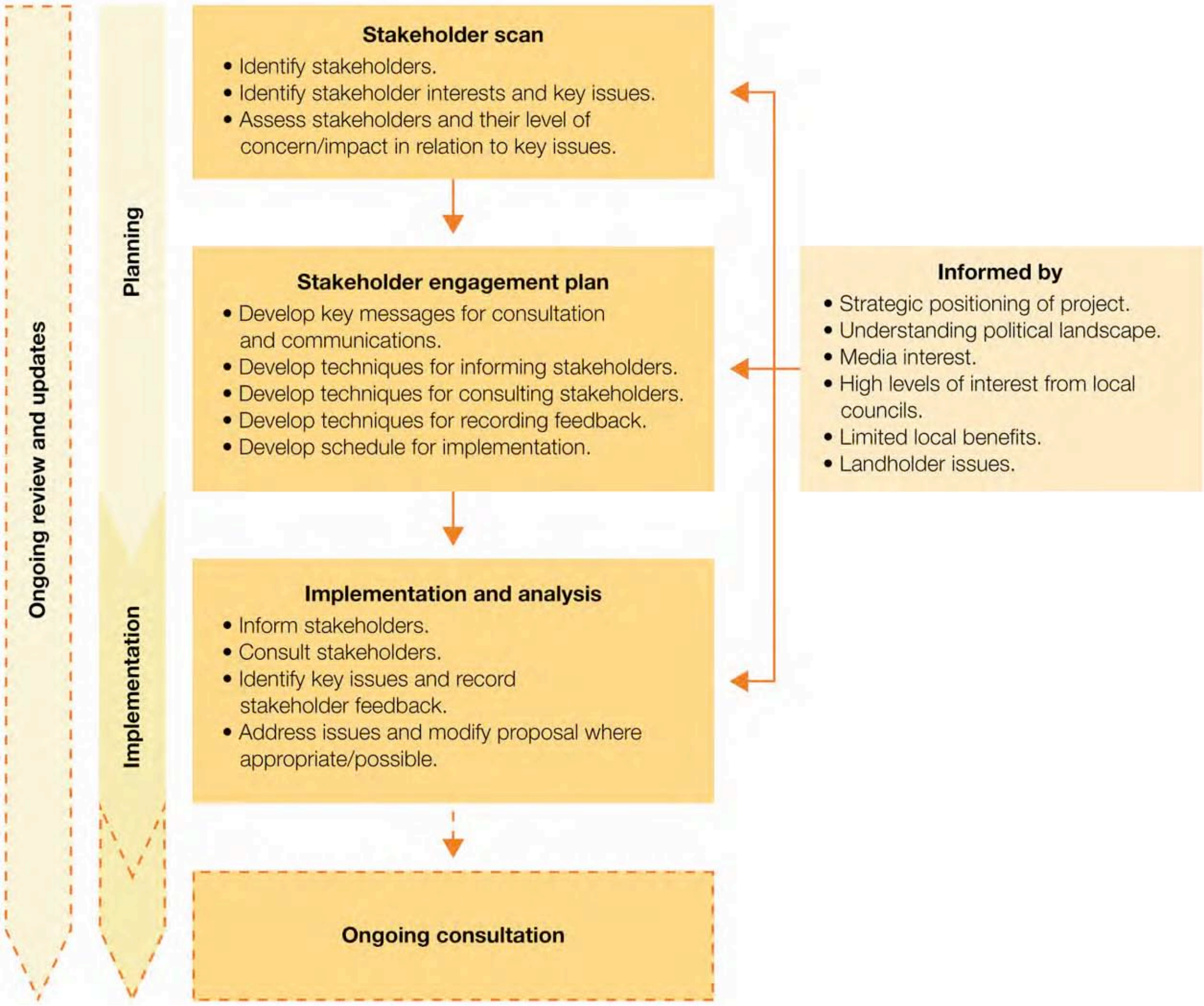
Information gathered during this process was used to inform the preparation of the stakeholder engagement plan. The stakeholder engagement plan developed the key messages to be used throughout the consultation process, proposed a range of integrated consultation techniques and a schedule for implementing the consultation process.

Implementation of the stakeholder engagement plan commenced in November 2007. A range of communication tools was used to both inform and seek responses from stakeholders. Key issues raised by stakeholders throughout the consultation process were recorded and incorporated into the EA process.

As shown in Figure 6.1, the methodology for stakeholder consultation was underpinned by a commitment to review and update the process on an ongoing basis. This ensured an inclusive and flexible approach and reflected the fact that stakeholder engagement is a dynamic process whereby the type of stakeholders, their role and key issues in relation to the proposal fluctuate over time.

The stakeholder consultation methodology adopted for this proposal aimed to foster an open and transparent flow of information and feedback between the project team and stakeholder groups during the development of and preparation of the EA, and for the duration of the proposal construction and operation phases.

Figure 6.1 Stakeholder consultation methodology



Consultation techniques

Throughout the consultation process, various techniques were used to both inform and consult with stakeholders regarding the proposal and to ensure that information regarding the proposal was easily accessible and appropriate to the broad variety of stakeholders.

Techniques used to provide information

The following techniques were used to provide stakeholders with accurate, consistent and accessible information regarding the proposal:

- Written correspondence.
- Information brochure – this included a background to the proposal, a map with indicative details of the Study Area, background to the consultation process for the proposal, details of the QHGP website and contact details for further information (see Appendix C for a copy of the brochure).
- Development of the QHGP website (www.qhgp.com.au) – the website is a comprehensive source of information on the proposal including background information, frequently asked questions, relevant maps and environmental information, a summary of the consultation approach and the approximate timeframe for the proposal. The website includes contact details for the project team and allows questions and enquiries

from the public, to be submitted directly from the website (see Appendix C for a copy of the website home page).

- Frequently asked questions (FAQs) sheet – this includes a response to many of the critical and most commonly asked questions in relation to the proposal eg approval process, the Study Area and construction impacts (see Appendix C for a copy of the FAQs).
- Stakeholder presentations.
- Community information hotline Ph: (02) 9411 4294. (A toll-free number will be arranged closer to construction).
- Proposal email address: contact@qhgp.com.au.
- Newspaper advertisements.
- Media briefings and media interviews.

An integrated stakeholder engagement process was used whereby different combinations of techniques were used with different stakeholders and communities. This approach was taken to reflect the different characteristics and needs of stakeholders and communities involved in the proposal.

Techniques used to seek feedback

The following techniques were used to seek feedback from stakeholders on their needs and key issues in relation to the proposal:

- Written correspondence.
- Telephone calls.
- Face-to-face stakeholder meetings.

Techniques used to record feedback

Throughout the stakeholder consultation process, a contact database has been maintained to keep a record of interactions with stakeholders and their key issues. Separate meeting notes were also prepared to keep a record of the outcomes and key issues from all stakeholder meetings held.

6.3 Approach

This section provides a brief overview of the consultation activities undertaken with key stakeholders and specific issues raised by stakeholders throughout the consultation process. Appendix C contains a comprehensive list of the activities and issues raised by stakeholders involved in the proposal, including reference to where specific stakeholder issues are addressed in the EA.

6.3.1 Overview of issues raised by stakeholders

A wide range of feedback was obtained throughout the development of the proposal, reflective of the many and diverse groups of stakeholders involved and the large geographic area covered by the proposal. In summary, the issues that have been consistently raised by stakeholders include:

- Corridor alignment.
- Compulsory easement acquisitions and compensation for affected landowners.

- Future access to CSG supplied by the pipeline.
- Impacts during the construction of the pipeline.
- Impacts of ongoing pipeline access/maintenance (particularly weed management).
- Potential environmental impacts including greenhouse gas impacts.
- Socio-economic impacts, eg availability of gas supply for local industry.
- Cultural impacts, eg potential impact on Aboriginal cultural heritage.
- Employment opportunities.
- Need for ongoing consultation with stakeholders throughout the planning and construction phases of the proposal.
- Potential employment or use of equipment during pipeline construction.

6.3.2 Government stakeholders

Consultation with State and Federal government departments is an ongoing process that will continue throughout the development of the proposal.

In September 2007, a meeting was held with the then Commonwealth Department of Environment and Heritage (now DEWHA). This meeting involved an introductory discussion about the pipeline proposal and a discussion regarding the requirements of the proposal in relation to Commonwealth legislation and matters of national environmental significance (further discussed in Chapter 7).

In November 2007, letters providing information on the proposal and offering face-to-face briefings were sent to the State and Federal MPs within whose electoral boundaries the Study Area falls. Briefings with the State and Federal MPs have been aimed at providing elected representatives with adequate information about the proposal to respond to constituent inquiries. Those State and Federal MPs, who have been personally briefed at the time of this submission, have stated their support for the pipeline.

In December 2007, following submission of the revised Preliminary Environmental Assessment (PEA), an assessment update meeting was held with representatives of the DPI, DECC, DWE and the DoP. The purpose of this meeting was to discuss the revised proposal and assessment approach, and specifically to seek agency feedback on key assessment issues and expectations.

Following this meeting, and as a result of agency review of the revised PEA, it was noted that the proposal differed in scope from the Part 3A application as made (in more than minor or peripheral terms), and hence a new Part 3A application reflecting these changes was made to the DoP in February 2008. The issues surrounding the assessment and approval pathway are discussed in Chapters 7 and 8.

6.3.3 Local councils

The Study Area passes through ten LGAs:

- Moree Plains Shire Council.
- Narrabri Shire Council.
- Gunnedah Shire Council.
- Liverpool Plains Shire Council.
- Upper Hunter Shire Council.

- Muswellbrook Shire Council.
- Singleton Council.
- Maitland City Council.
- Port Stephens Council.
- Newcastle City Council.

The project team has actively engaged each of these councils and is continuing to meet with councillors, council executives, and council officers to discuss the Study Area, construction impacts, future access to gas, employment opportunities, and regional growth. The project team is developing an ongoing relationship with local councils, with regular contact through meetings, presentations, phone calls and emails.

In November 2007, a letter was sent to each of the local councils to introduce the proposal and the project team. Following the letter, meetings were arranged with council representatives throughout November and December 2007. The meetings involved a presentation to councils detailing the proposal background, project team, the Study Area, socio-economic and environmental benefits of the proposal and the planning and environmental assessment process. The meetings were also an opportunity for council representatives to raise any initial issues and areas of concern.

In December 2007, following the meetings and presentations with councils, a further letter was sent to councils advising of the preparation of the EA and requesting cooperation and assistance from councils to capture the local environmental and future planning issues that should be considered within each local government area. In April 2008, further meetings were held with local councils in order to provide councils with feedback on the results of initial EA works, specific to each local government area.

In general, councils have offered support to the pipeline proposal and have asked to be involved and consulted throughout the future development of the proposal. The questions and key issues raised by councils during the consultation process to date, relate to:

- The process for landowner negotiations and compulsory acquisitions.
- Potential customers of the proposed gas pipeline.
- Other land uses within the Study Area.
- Aboriginal heritage.
- Environmental impacts and rehabilitation of land following construction.
- Impacts on agricultural lands.
- The location of existing and future infrastructure within or near the Study Area.
- Potential benefits and employment for local areas.
- Community consultation and the need for ongoing consultation with local councils.
- Impacts on other infrastructure.

Consultation with councils is ongoing and will include phone calls, written correspondence, meetings and presentations. A complete listing of councils involved in the proposal, consultation undertaken to date and key issues raised, can be found in Appendix C.

6.3.4 Consultation with landowners

The project team recognises the critical importance of landowners situated in the Study Area. Consultation, engagement and negotiation activities have been targeted to ensure landowners' specific concerns are understood and adequately addressed. In November 2007, a letter was sent to 670 landowners to advise them of the proposal and the location of their land parcel in relation to the Study Area. Enclosed with the letter was an information brochure, details of the QHGP website and contact details for project team representatives. Since this time, the members of the project team have been in contact with landowners by phone to follow up the letters and, during February, March and April 2008, in person to seek permission to survey their properties. Many landowners have also subscribed to receive proposal updates via the QHGP website. It is anticipated that around 431 landowners will have land parcels impacted by the ROW. At the time of submission, meetings had been held with a total of 367 landowners representing 81 per cent of the anticipated ROW.

The key issues and concerns that have emerged from consultations undertaken with landowners to date relate to:

- Impacts to private property during the construction and ongoing operation of the proposed pipeline.
- Weed management.
- Impacts on specific land uses such as irrigation and horse studs.
- Noise and traffic impacts.
- Access to private property.
- Impacts on privacy.
- Compensation and compulsory easement acquisitions.
- Ongoing consultation.

Consultation with landowners is ongoing and long-term relationships are being developed to ensure that landowner issues and concerns are effectively identified and addressed throughout each phase of the proposal.

Following this phase of consultation with landowners, their input has helped to further refine the Study Area to ensure that minimal disturbance occurs during construction, and ongoing operation of the pipeline.

6.3.5 Statutory bodies

The statutory bodies that have been engaged in the stakeholder consultation for the proposal include:

- Catchment Management Authorities (CMA).
- Rural Lands Protection Boards.
- Mines Subsidence Board.
- Regional Development Boards.
- Landcare networks.

In January 2008, letters were sent to statutory bodies providing background information on the pipeline proposal (including a copy of the proposal brochure) and seeking feedback on key issues for consideration in the EA. The feedback received from statutory authorities to date has covered issues such as:

- Impacts on items of Aboriginal heritage.
- Rehabilitation of land and weed control following construction works.

- Environmental impacts such as erosion, salinity and water quality impacts.
- The location of coal resources and mining areas.
- Impacts on travelling stock routes.

6.3.6 Utilities and transport stakeholders

The consultation activities undertaken with utilities and transport infrastructure providers to date have been aimed at gaining an understanding of the location and extent of utilities and infrastructure within or in proximity to the Study Area. Consultation undertaken with utilities and transport stakeholders has included consultation with the RTA and the ARTC. Refer to Appendix C for a list of utilities contacted and issues raised.

In January 2008, letters were sent to a range of utilities and transport stakeholders to give an introduction to the proposal and seek information on their issues. The feedback received from utilities and transport stakeholders so far relates to the location of infrastructure throughout the corridor and the need for ongoing consultation to manage construction and operational impacts.

Further consultation with these stakeholders will be undertaken during the detailed design stage of the proposal. This will assist in developing a comprehensive understanding of the location of utilities and infrastructure throughout the corridor and will inform the final route alignment and construction approach. Refer to Chapter 16 for further details on the infrastructure issues involved in the proposal.

6.3.7 Aboriginal stakeholders

Consultation with Aboriginal stakeholders is being undertaken in accordance with the DECC, *Interim Consultation Requirements for Applicants* (2004). In accordance with these requirements, in December 2007, advertisements were published in local newspapers along the Study Area inviting Aboriginal groups or individuals to register their interest in the proposal. Notification was also mailed to known Aboriginal stakeholders and groups.

The registrations received from the newspaper advertisements along with the results of research and contact with key Aboriginal groups revealed a large and diverse range of stakeholders for the proposal. These stakeholders are:

- Local Aboriginal Land Councils.
- Traditional owner groups.
- Community members with interests in Aboriginal heritage.
- Local Aboriginal corporations.
- Neighbourhood centres in areas highly populated with Aboriginal people.
- Aboriginal reference panels within the Study Area.
- The Department of Aboriginal Affairs.

In January 2008, letters were sent to Aboriginal stakeholders inviting attendance at meetings throughout February 2008 to discuss the proposed methodology for the assessment of Aboriginal heritage within the Study Area.

In February 2008, meetings were held with Aboriginal stakeholders in Newcastle, Maitland, Muswellbrook, Gunnedah, Narrabri, Moree and Mungindi. The meetings involved a presentation to Aboriginal stakeholders including the history and background of the proposal and the proposed methodology for the future assessment of Aboriginal heritage within the Study Area. The meetings also sought input from knowledge holders to identify sites or places of cultural significance that may be within the Study Area or may be affected by the proposal.

Following the meetings, registered Aboriginal stakeholders were sent copies of the cultural heritage methodology presentation and maps of the Study Area and given 21 working days to make written or verbal submissions in accordance with the DECC *Interim Community Consultation Requirements for Applicants*. Following a realignment of the corridor, new maps were sent to Aboriginal stakeholders and a further 21 working days provided for submissions. The draft *Concept Approval Aboriginal Heritage Assessment* report was also sent to Aboriginal stakeholders with 21 days for feedback. Comments received from all of these processes were incorporated into the EA.

Throughout the consultation process with Aboriginal stakeholders the key issues raised to date in relation to the proposal have been:

- Avoiding impacts on items and places of cultural significance.
- Developing adequate protocols to manage any potential adverse impacts.
- Opportunities for sustainable programs (such as traineeships or employment opportunities) for Aboriginal people.
- Compensation for loss of items of cultural significance.
- Payment of royalties.

Consultation, including meetings, with Aboriginal stakeholders regarding the proposal is ongoing to ensure issues and concerns are identified and addressed. The proponent has committed to meeting with Aboriginal stakeholders to discuss issues not directly related to the cultural heritage assessment, such as employment/traineeships and other matters.

6.3.8 Broader community

As well as the more targeted stakeholder consultation process, a proactive media program was implemented during February and March 2008 to raise broader community awareness about the proposal within the Study Area. This program included sending letters to local print and radio media advising of the proposal, and offering a briefing if required. In response to this, several stories have been published in the local papers and a number of interviews were conducted with local radio and television stations. The list of media contacts, and the articles published so far have been included in Appendix C, and the media program will be ongoing throughout the life of the project.

6.4 How stakeholders have influenced the proposal

The stakeholder consultation methodology for this proposal, as illustrated in Figure 6.1, was designed to be flexible and responsive so that issues raised by stakeholders could be investigated and, where appropriate, incorporated into the proposal.

Discussions with individual landowners have resulted in several realignments of the Study Area to:

- Minimise impacts to riparian vegetation around watercourses.
- Avoid cultural items such as scarred trees based on local knowledge of landowners.
- Avoid/minimise erosion around watercourses.

- Relocate to dry land areas rather than irrigated land.
- Relocate to open grasslands to avoid cultivated areas.
- Minimise impacts on irrigation activities.

A number of horse studs are located in the areas around Scone and Murrurundi. Discussions with operators have indicated that horse-breeding cycles would need to be taken into account during the construction phase to minimise impacts on the animals. This issue is discussed further in Chapter 13 on land use. Ongoing discussions with landowners will help the project team further refine the ROW and determine the most suitable route across their land to minimise disturbance to their livelihood and land use prospects.

Feedback from utilities and transport infrastructure stakeholders has influenced the design and alignment of the pipeline to address issues such as:

- Avoiding interference with future road works.
- Avoiding interference with future rail works.
- Avoiding existing water, electricity and telecommunications infrastructure.
- Avoiding interference with CP systems.

Consultation with local councils has influenced the realignment of the corridor by identifying issues such as:

- Avoiding planned future residential and industrial developments.
- Avoiding congested urban areas.
- Minimising passage through flood-prone areas.
- Minimising passage through areas of reactive clay soils.

Consultation with government departments and statutory bodies has impacted on route selection and pipeline design by identifying issues such as:

- Impacts on Crown land and Crown road reserves.
- Avoiding TSRs and areas of high-value remnant vegetation.
- Avoiding mine subsidence areas.
- Avoiding mining leases.

Consultation with Aboriginal communities has highlighted the location of significant ceremonial and historical sites located on or near the pipeline corridor such as:

- Missions.
- Massacre sites.
- Burial grounds.
- Scarred and carved trees.

The alignment of the corridor south of Boomi will be surveyed in consultation with local Aboriginal elders to confirm the boundaries of the former Euraba Mission so that this significant site can be avoided. Section 10.1 provides more detail of Aboriginal sites and how the proposal would seek to avoid or mitigate impacts.

Specific changes to the pipeline alignment arising from feedback from stakeholders are discussed in more detail in Section 3.6.

6.5 Future consultation

The QHGP project team recognises that there are a number of competing interests in developing a proposal of this scope. The team is committed to open, transparent and ongoing communication and feedback with stakeholders throughout each phase of the proposal to help manage stakeholder expectations. The results of ongoing consultation will continue to influence the details of the proposal, and inform the management of adverse impacts.

Consultation has been viewed as a vital component of the proposal, underpinning the overall planning approach. Should the proposal be approved, an integrated stakeholder consultation process would continue to be a central pillar of the proposal throughout any future stages of assessment through to construction and operation.

In recognition of the important role that particular departments will play during all phases of the project, the proponent intends to establish a framework for a government liaison group to enable regular consultation with the representatives of DECC, DPI, DWE, DoP and other relevant agencies.

7 Statutory requirements

7.1 Introduction and background

As a consequence of its location partially within Queensland and partially within NSW, the QHGP is subject to the requirements of a range of legislation within these jurisdictions and at the Commonwealth level. The QHGP has received relevant licences/approvals in Queensland under the *Petroleum and Gas (Production and Safety) Act 2004* and the *Environment Protection Act 1994*. In the NSW context, assessment of the proposal has been underway since early 2006. The process to date has been:

- January 2006 – Assessment of the QHGP commences under Part 5 of the EP&A Act.
- February 2006 – Planning focus meeting is held.
- March 2006 – DoP DGRs for the preparation of an environmental impact statement (EIS) under Part 5 of the EP&A Act are issued.
- October 2006 – Assessment transitions to Part 3A of the EP&A Act and project approval is sought.
- November 2006 – DGRs under Part 3A are issued.
- December 2006 – Draft Part 3A environmental assessment is submitted to the DoP for review of adequacy.
- February 2007 – Comment from the DoP, the then Department of Environment and Conservation, Department of Natural Resources and DPI is received.
- May 2007 – Following consideration of agency comment on the draft EA, a decision is made to revisit the route development and selection process with a greater focus on identifying and avoiding key environmental constraints. The concept plan assessment and approval process under Part 3A of the EP&A Act is identified as the appropriate vehicle for the revised approach.
- November 2007 - A revised PEA is submitted to the DoP.
- December 2007 - An assessment update meeting was held with government agencies to explore expectations around the assessment of key environmental issues associated with the proposal. A request for authorisation to prepare concept plan was lodged with the DoP. Following agency review of the revised PEA, it was noted that the proposal differed in scope from the 2006 Part 3A application, as made (in more than minor or peripheral terms), hence a new Part 3A application reflecting these changes was lodged with the DoP.

The following sections describe in greater detail the legislative framework within which the proposal is now being assessed, and through which approval is being sought. Section 7.3 also provides details of the process and indicative timing of relevant approvals required under Commonwealth legislation, including how this approval process is proposed to be coordinated with the approval process under NSW legislation.

7.2 New South Wales legislation

7.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act provides a framework for environmental planning and assessment in NSW. Part 3A of the EP&A Act provides an assessment and approval process for major infrastructure projects. Clause 6 and Schedule 1 of the Major Projects SEPP identifies development to which Part 3A of the EP&A Act applies. Clause 6 provides:

> *Development that, in the opinion of the Minister, is development of a kind:*
>
> *(a) that is described in Schedule 1 or 2…*

Schedule 1 Item 26A provides:

> *Development for the purposes of a pipeline in respect of which:*
>
> – *a licence is required under the Pipelines Act 1967, or*
>
> – *an application for a licence is made under that Act or after the commencement of this clause, or*
>
> – *a licence was granted under that Act before the commencement of this clause.*

Hunter Gas Pipeline Pty Ltd proposes to make an application for a licence under the *Pipelines Act 1967*. The proposal is within the scope of the item referred to above and therefore becomes a project to which Part 3A applies.

Critical infrastructure

The Minister for Planning has declared that the QHGP is a 'critical infrastructure project' under Section 75C (gazetted 13 June 2008) of the EP&A Act as, in the opinion of the Minister, the proposal is essential to NSW for economic, environmental and/or social reasons.

Critical infrastructure projects such as the QHGP have impacts and benefits that extend beyond a single local government area and across the areas of responsibility of a number of government departments. The NSW Government has decided that the best way of progressing these projects is to increase certainty and reduce the potential for delays by streamlining the number of separate approvals that apply to the project.

Queensland Hunter Gas Pipeline concept plan

Section 75M of the EP&A Act states that the Minister for Planning may authorise or require the proponent to submit a concept plan for a Part 3A project. Building on the relevant proposal history outlined in Section 7.1, and following substantial changes to the proposal, Hunter Gas Pipeline Pty Ltd submitted a Major Project Application accompanied by a PEA and a request to the Minister for Planning for authorisation to prepare a concept plan. The decision to pursue a concept plan approval was based around the following:

- Earlier certainty and statutory endorsement of a preferred option via concept plan approval, especially relevant considering the scale of the proposal.
- The provision of a greater level of certainty to commence necessary acquiring of easements, while retaining flexibility for the refinement of design.
- A more field focussed investigation and resolution of specific issues identified via the concept plan process, prior to construction.

The process under Part 3A for the assessment and approval for a project is shown in Figure 7.1 and described as follows:

Stage 1 – Requirement for Submission of Concept Plan

The Minister for Planning may require the proponent of a project to lodge a concept plan.

The Minister for Planning on 11 February 2008 authorised Hunter Gas Pipeline Pty Ltd to lodge a concept plan for the QHGP.

Stage 2 – Environmental Assessment Requirements

The Director-General of the DoP, in consultation with relevant public authorities, prepares and issues environmental assessment requirements for the concept plan under Sections 75F and 75N of the EP&A Act. The environmental assessment requirements may require an environmental assessment to be prepared. The Director-General may require the proponent to include in the environmental assessment SoCs the proponent is prepared to make for environmental management and mitigation measures.

The Director-General issued DGRs for the proposal on 3 March 2008. These, together with a table cross-referencing where in the EA the DGRs are addressed, are reproduced in Appendix A.

Stage 3 – Preparation of Environmental Assessment

Hunter Gas Pipeline Pty Ltd prepares an EA which addresses the DGRs and submits it to the Director-General in accordance with Section 75H of the EP&A Act.

This document is the EA for the QHGP.

Stage 4 – Public exhibition

If the Director-General considers the EA to be adequate, in terms of addressing the DGRs, the EA is placed on public exhibition for a period of not less than 30 days. During this period, any person (including a public authority) may make a written submission to the Director-General.

Stage 5 – Consideration of public submissions

The Director-General provides copies of submissions received to the proponent or alternatively may prepare and issue to the proponent a report on the issues raised. The Director-General considers the submissions and may require the proponent to:

- Submit to the Director-General a response to the issues raised in the submissions.
- Prepare a preferred project report (PPR) that outlines any proposed changes to the project to minimise its environmental impact.
- Prepare a revised SoCs.

If any significant changes are proposed following public exhibition, the Director-General may require the Hunter Gas Pipeline Pty Ltd to make the PPR available to the public.

Stage 6 – Preparation of Director-General's report

The Director-General of the DoP prepares a report under Section 75I and 75N of the EP&A Act and gives a copy of that report to the Minister for the purposes of the Minister's consideration of the application for approval of the concept plan.

Stage 7 – Minister's decision

The Minister decides whether or not to approve the concept plan for the proposal under Section 75O of the EP&A Act. If the decision is to grant approval, the Minister for Planning may under Section 75P of the EP&A Act:

- Determine further EA requirements for approval to carry out the proposal under Part 3A of the EP&A Act (75P(1)(a)).
- Determine that approval to carry out the proposal is to be subject to the other provisions of the EP&A Act (75P(1)(b)).
- Determine that no further EA is required for the proposal, in which case the Minister may approve the proposal under Part 3A without any further application, EA or report (75P(1)(c)).

The proponent is seeking approval under Section 75P(1)(c) of the EP&A Act, based on the rationale presented in Section 1.3.3.

Figure 7.1 Part 3A approval process for the proposal

Proposed modifications

As the EA has necessarily been carried out ahead of the detailed design phase and completion of the landowner negotiations, it is inherent in the nature of pipeline design and construction that some flexibility is required in final route alignment. This is demonstrated in the need for ongoing route alignment refinement, as outlined in Section 3.

, and the undertaking of fieldwork for adaptive management as outlined in Chapter 18.

The proponent intends to adopt a documented and transparent process for conducting a consistency review against the approval to determine if proposed modifications to the proposal are consistent or not consistent with the Part 3A approval for the proposal. If proposed modifications are not consistent with the Minister's approval under Part 3A approval, then the proponent would apply for a modification of the approval in accordance with Section 75W of the EP&A Act.

Consistency assessments for proposed pipeline alignment changes would be developed and undertaken to document and determine:

- Alignment changes, by allocating an alignment revision change or a nominated change number.
- Consistency against each of the proposal objectives.
- Impacts and changes from the proposed modification. This would be determined through a desktop assessment of each of the environmental issues assessed in this EA by applying the same methodology as presented in Part B. Any potentially significant impacts identified would be the subject of further detailed investigation or management.

The outcomes of the consistency review would be used to determine if the proposed modifications could be undertaken so as to satisfy the requirements of the Ministers conditions of approval or the SoCs (refer to Chapter 19 for draft SoCs).

The consistency assessment would be undertaken and/or coordinated by the environmental manager for the project. Consistency assessments associated with proposed modifications would be retained and be made available on request.

7.2.2 Other approvals and legislative requirements

If the Minister grants approval under Part 3A then Section 75U of the EP&A Act provides that the following approvals would not be required:

- Concurrence under Part 3 of the *Coastal Protection Act 1979.*
- Permit under Section 201*, 205 or 219* of the *Fisheries Management Act 1994.*
- Approval under Part 4*, or an excavation permit under Section 139*, of the *Heritage Act 1977.*
- Permit under Section 87* or a consent under Section 90* of the *National Parks and Wildlife Act 1974.*
- Authorisation referred to in Section 12* of the *Native Vegetation Act 2003* to clear native vegetation or State protected land.
- Permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948*[1].
- Bushfire safety authority under Section 100B of the *Rural Fires Act 1997.*

1 This Act was repealed on 4 February 2008 and generally replaced by the requirements of Part 3 of Chapter 3 of the *Water Management Act 2000* as referred to below.

- Water use approval under Section 89*, water management work approval under Section 90* or an activity approval under Section 91* of the *Water Management Act 2000*[2].

Of these, the approvals marked with an asterisk may be relevant to QHGP in relation to Section 75U of the EP&A Act.

If the Minister grants an approval for the proposal under Part 3A, then Section 75V of the EP&A Act provides that the following relevant approvals under other legislation, if required, cannot be refused:

- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in Section 43 of that Act).
- Consent under Section 138 of the *Roads Act 1993*.
- Approval under Section 15 of the *Mine Subsidence Compensation Act 1961*.
- A licence under the *Pipeline Act 1967*.

There are other statutory approvals that may be required, including:

- A reserve use permit under Section 100 of the *Rural Lands Protection Act 1998.*
- A licence under Section 45 and the creation of an easement under Section 52 of the *Crown Lands Act 1989.*
- Approvals under the *Water Act 1912* for access to ground or surface water, or for interactions with shallow groundwater, during construction.

Whether or not a formal statutory approval is required, the proponent consulted (refer Chapter 6 and Appendix C for details) with the following government departments and agencies to inform them about the QHGP and obtain their input:

- NSW DECC.
- NSW DPI.
- NSW Department of Aboriginal Affairs.
- Relevant CMAs.
- NSW DWE.
- DEWHA.
- Country Energy.
- Transgrid.
- NSW RTA.
- ARTC.
- NSW Department of Lands.
- Relevant RLPBs.
- NSW Mine Subsidence Board.
- Relevant local councils.

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2 Though these approvals are not required, management and mitigation measures proposed in relation to QGHP will be informed by the same duty of care sought to be achieved by these approvals.

7.2.3 Environmental planning instruments

The relevance of environmental planning instruments to the Part 3A concept plan assessment and approval process is dictated by 75O(3) of the EP&A Act.

Section 75O(3) states:

> *In deciding whether or not to give approval for the concept plan for a project, the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of Section 75R) apply to the project if approved. However, the regulations may preclude approval for a concept plan for the carrying out of a class of project (other than a critical infrastructure project) that such an instrument would otherwise prohibit.*

In recognition of the Minister's discretion to consider the provisions of environmental planning instruments, a review has been undertaken to identify those that may be relevant. They are listed below.

State Environmental Planning Polices

- State Environmental Planning Policy No. 44 – Koala Habitat Protection.
- State Environmental Planning Policy (Major Projects) 2005.
- State Environmental Planning Policy No. 14 – Coastal Wetlands.
- State Environmental Planning Policy No. 55 – Remediation of Land.
- State Environmental Planning Policy (Infrastructure) 2007.

Regional Environmental Plans

- Hunter Regional Environmental Plan 1989.
- Hunter Regional Environmental Plan 1989 (Heritage).

Local Environmental Plans

- Port Stephens Local Environmental Plan 2000.
- Maitland Local Environmental Plan 1993.
- Narrabri Local Environmental Plan No 2.
- Narrabri Local Environmental Plan 1992.
- Narrabri Local Environmental Plan No. 5 (Township of Boggabri).
- Singleton Local Environmental Plan 1996.
- Quirindi Local Environmental Plan 1991.
- Parry Local Environmental Plan 1987.
- Scone Local Environmental Plan 1986.
- Murrurundi Local Environmental Plan 1993.
- Gunnedah Local Environmental Plan 1998.
- Merriwa Local Environmental Plan 1992.
- Muswellbrook Local Environmental Plan 1985.
- Moree Plains Local Environmental Plan 1995.

- Newcastle Local Environmental Plan 2003.

7.2.4 Water management issues

Water would be required for hydrostatic testing, dust suppression, potable water supply for drinking and potable water supply for construction camps (for further information see Section 17.1). Currently, two different Acts administer access to water resources, the *Water Management Act 2000* and the *Water Act 1912* and impose different access and licensing requirements.

Under the *Water Management Act 2000*, there are three types of approvals that, but for the operation of Section 75U(1) of the EP&A Act, would likely apply to the proposal. Under Section 75U(1) of the EP&A Act, projects approved under Part 3A do not require a water use approval under Section 89, a water management work approval under Section 90 or an activity approval under Section 91 of the *Water Management Act 2000*. However, the *Water Management Act 2000* only applies to the extent that a water sharing plan under the *Water Management Act 2000* has commenced in relation to a water source.

Surface water is administered under Part 2 of the *Water Act 1912*. An embargo presently applies to the making of applications for new licences under Part 2. Groundwater is administered under Part 5 of the Water Act 1912. In contrast to the *Water Management Act 2000*, from which Section 75U of the EP&A Act provides exemption for Part 3A projects, there are no exemptions under the *Water Act 1912* (either under Part 2 or Part 5).

In addition to the legislation cited above, there is a range of relevant water management policies which have been considered when assessing impacts to the proposal as follows:

- NSW Groundwater Policy Framework Document: a high level framework recognising the importance of groundwater as a resource for environmental, social and economic uses for the people of NSW and aimed at ensuring sustainable management of groundwater both as to quantity quality and dependent ecosystems.
- NSW Groundwater Quantity Management Policy: recognises that groundwater and surface water are closely integrated as one resource and aims to ensure the sustainable management of groundwater extraction.
- NSW Groundwater Quality Protection Policy: to protect groundwater from contamination and degradation.
- NSW Groundwater Dependent Ecosystem Policy: to identify and classify groundwater dependent ecosystems to ensure water is provided to meet environmental needs.
- NSW State Rivers and Estuaries Policy: framework for sustainable management of rivers and estuaries and related ecosystems with a total catchment philosophy.
- NSW Wetlands Management Policy: encouraging the management of wetlands to halt and where possible reverse environmental degradation.
- NSW Farm Dams Policy: regulates farm dams and harvestable rights.
- NSW Weirs Policy: to discourage the building of new weirs and remove weirs no longer providing significant benefits.

The proponent is currently in consultation with DWE to clarify the specific operation of these policies and statutes with respect to the QHGP.

7.3 Commonwealth legislation

7.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), approval from the Commonwealth Minister for the Environment, Heritage and the Arts is required for an action that is:

- Likely to have a significant impact on a 'matter of national environmental significance' (NES).
- Carried out on Commonwealth land and is likely to have a significant impact on the environment.
- Carried on outside of Commonwealth land but is likely to have a significant impact on the environment on Commonwealth land.

Matters of NES include:

- World Heritage properties.
- National heritage places.
- Listed migratory species.
- Wetlands of international importance.
- Commonwealth marine areas.
- Threatened ecological communities and threatened species.
- Nuclear actions.

The QHGP is not proposed to be undertaken on Commonwealth land nor would it be likely to have a significant impact on Commonwealth land. The QHGP does not affect Commonwealth marine areas, nor does it constitute a nuclear action. Careful route selection has avoided World Heritage properties and national heritage places.

Therefore NES matters that are potentially relevant to the QHGP relate to:

- Nationally threatened species and ecological communities: the pipeline passes through five bioregions that contain a variety of relevant flora and fauna.
- Listed migratory species: various wetland birds.
- Wetlands of international significance: The pipeline passes close to the Hunter River Estuary Wetlands. The pipeline route avoids the Gwydir Wetlands and Myall Lakes though it passes in the vicinity of the catchment areas for each.

Assessment of the impacts on these NES matters is referred to in Chapters 9 and 15.

A referral will be made to the Commonwealth in September 2008 on the basis that the QHGP be considered for suitability under Section 77A of the EPBC Act as an action that is not controlled, if taken in accordance with the manner specified in the draft SoCs.

7.3.2 Other Commonwealth legislation

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* provides protection of places of significance to Aboriginal people. Aboriginal people who believe that a place or object is threatened and believe that state government processes offer inadequate protection can apply to the Commonwealth Minister for the Environment, Heritage and the Arts to protect that place or object.

The *Native Title Act 1993* allows for recognition of native title through a claims and mediation process and also sets up a regime for obtaining interests in land or waters where Native Title exists through Indigenous Land Use Agreements. The National Native Title Tribunal administers the Act.

Native Title is the communal, group or individual rights and interests of the indigenous people of Australia in relation to their traditional land and waters, as recognised by the common law of Australia and the *Native Title Act 1993*. Native Title will only exist in relation to a particular area of land if the indigenous people in question have maintained a continuing connection to their traditional land or waters and their native title rights and interests have not been extinguished by a grant of tenure or use of land by the Crown or a third party.

8 Environmental assessment process

8.1 Environmental assessment requirements

The QHGP has been declared critical infrastructure status (gazetted 13 June 2008) under Part 3A of the EP&A Act and the Minister for Planning has authorised the lodgement of a concept plan for the proposal. The DGRs identified the following key issues for consideration and assessment:

- Ecological impacts.
- Heritage impacts (Aboriginal heritage).
- Human amenity impacts (relating to noise and vibration, air quality and traffic).
- Socio-economic implications.
- Land use planning impacts.
- Hazards and risk impacts.
- Surface and groundwater impacts.
- Infrastructure impacts.

This chapter sets out the steps that have been undertaken in preparing this EA.

8.2 Environmental risk assessment

8.2.1 Overview and environmental risk assessment methodology

The environmental risk assessment is an important step in the process of assessment of environmental impacts and is required as part of the DGRs. In particular it is used to guide the scoping of environmental investigations and assessments, guide proposal design, assist in identifying appropriate mitigation measures and management responses, and to identify potentially significant residual impacts.

The environmental risk assessment has been performed in accordance with the principles of *AS/NZS4360:2004*. The risk of each identified potential impact has been ranked by identifying the consequences of the impact and the likelihood of it occurring. The probable effectiveness of the proposed mitigation measures is then considered to determine the residual risk of each impact.

The risk rating categories determined through the analysis are summarised in Table 8.1.

Table 8.1 Risk rating categories

Risk rating score	Risk category	General description
1, 2 or 3	High	Detailed assessment and planning necessary to develop appropriate measures to mitigate and manage the potential impacts.
4 or 5	Medium	Potential impacts can be mitigated through the application of relatively standard environmental management measures.
6	Low	Potential impacts either require no specific management measures or are mitigated adequately through other working controls (such as detailed design requirements, normal working practice, quality and safety controls).

The consequence definitions used in determining the risk rating are given in Table 8.2.

Table 8.2 Risk assessment consequence definitions

Consequence level	Definition
Catastrophic	• Would result in a major prosecution under relevant environmental legislation. • Would cause long-term and irreversible impacts.
Major	• Would result in a fine or equivalent under relevant environmental legislation. • Would cause medium-term, potentially irreversible impacts.
Moderate	• Would result in a medium-term, reversible impacts.
Minor	• Would result in short-term, reversible impacts.
Insignificant	• Would not result in any impacts.

By considering the frequency of activities that may cause the impact and the probability of the impact occurring during that activity, the likelihood of each identified impact occurring is also used in determining the risk rating and has been classed as:

- Very likely – almost certain to occur in the course of normal or abnormal operating circumstances.
- Likely – event is likely to occur in the course of normal operations.
- Unlikely – event could occur in the course of normal or abnormal operating circumstances.
- Very unlikely – event may occur in exceptional circumstance.

The risk rating of each potential impact is then determined through combining the consequence and likelihood according to the following matrix.

Table 8.3 Risk matrix

Consequences	Likelihood: Very likely	Likely	Unlikely	Very unlikely
Catastrophic	1	1	2	3
Major	1	2	3	4
Moderate	2	3	4	5
Minor	3	4	5	6
Insignificant	4	5	6	6

The potential effectiveness of the mitigation measures proposed in the following chapters was then assessed and the degree of effectiveness of mitigations classed as either:

- Very effective – increases risk rating score by three points (eg from 3 – high to 6 – low).
- Effective – increases risk rating score by two points (eg from 2 – high to 4 – medium).
- Partly effective – increases risk rating score by one point (eg from 3 – high to 4 – medium).
- Not effective – no change in risk rating.

8.2.2 Environmental risk assessment analysis

The risk assessment was based on information from the impact assessment, construction experience on similar pipeline projects and experience with linear infrastructure projects. A workshop to review the potential risks associated with the project was conducted with key members of the project team and the environmental assessment consultants. The assessment took specific regard to the mitigation and management measures developed and put forward in the *APIA Code of Environmental Practice* and to the principles for ecologically sustainable development. The results of the environmental risk workshop are summarised in Table 8.4.

Table 8.4 Environmental risk assessment results

Environmental issues		Assessment of potential impacts			Assessment of proposed mitigations			
Aspects	**Potential impacts**	**Overall consequence**	**Overall likelihood**	**Risk rating**	**Proposed mitigation measures**	**Effectiveness**	**Factor**	**Residual risk rating**
Pipeline construction and commissioning								
Biodiversity (Ecology)	• Clearing of Endangered Ecological Communities (EECs). • Loss of habitat for threatened species. • Adverse impacts on plants and animals, including impacts on habitat. • Potential longer term impacts associated with increased habitat fragmentation.	Major	Likely	2	Chapter 9	Effective	**2**	4
Aboriginal heritage	• Disturbance of Aboriginal objects and places. • Potential destruction of these objects and places. • Disturbance of archaeological deposits and cultural values associated with the landscape.	Major	Likely	2	Section 10.1	Effective	**2**	4
Historical heritage	• Adverse impacts on historical heritage sites. • Potential to destroy heritage items and places not listed on any statutory register.	Major	Unlikely	3	Section 10.2	Effective	**2**	5

Environmental issues		Assessment of potential impacts			Assessment of proposed mitigations			
Aspects	**Potential impacts**	**Overall consequence**	**Overall likelihood**	**Risk rating**	**Proposed mitigation measures**	**Effectiveness**	**Factor**	**Residual risk rating**
Noise and vibration	• Noise levels adversely impact human amenity. • Vibration levels adversely impact human amenity. • Vibration levels cause damage to buildings. • Air blast causes damage to structures and injury to people.	Major	Likely	2	Section 11.3	Effective	**2**	4
Traffic and transport	• Disruption of traffic and transport services, both local and through traffic.	Minor	Very likely	3	Section 11.5	Effective	**2**	5
Air quality	• Dust and exhaust levels adversely impact human amenity. • Venting of gas during commissioning.	Minor	Very likely	3	Section 11.4	Partly effective	**1**	4
Socio-economic	• Increased pressure on social services. • Disruption to local community during construction. • Impact of temporary modification to property access.	Minor	Likely	4	Chapter 12	Effective	**2**	6
Land use	• Adverse impact on current and potential future uses of land. • Reduction in current available land uses.	Moderate	Likely	3	Chapter 13	Effective	**2**	5
Hazards and risks	• Damage to property or human health resulting from an emergency incident. • Bushfire from spark emitting construction activities.	Catastrophic	Very unlikely	3	Chapter 14	Very effective	**3**	6

Environmental issues		Assessment of potential impacts			Assessment of proposed mitigations			
Aspects	**Potential impacts**	**Overall consequence**	**Overall likelihood**	**Risk rating**	**Proposed mitigation measures**	**Effectiveness**	**Factor**	**Residual risk rating**
Surface and groundwater	• Adverse impacts on surface and groundwater quality. • Adverse impacts of waterway morphology.	Moderate	Likely	3	Chapter 15	Effective	**2**	5
Infrastructure	• Disruption of key national and state infrastructure (highways, interstate rail network etc). • Disruption of other services (rail, road, electricity etc).	Catastrophic	Unlikely	2	Chapter 16	Very effective	**3**	5
Waste	• Adverse impacts on land resources due to excess waste sent to landfill. • Adverse impacts from discharge of hydrostatic test water.	Minor	Unlikely	5	Section 17.1	Partly effective	**1**	6
Contamination	• Disturbance of contaminated soils causing land or water pollution. • Contamination of land through spills of fuels or chemicals.	Moderate	Unlikely	4	Section 17.2	Effective	**2**	6
Geology and soils	• Adverse impacts on the productivity of soils through changes in structure, erosion, landslip and subsidence.	Moderate	Unlikely	4	Section 17.3	Effective	**2**	6
Visual amenity	• Construction activities adversely impacting human amenity. • Removal of vegetation through forested areas in right of way.	Minor	Likely	4	Section 17.4	Effective	**2**	6
Greenhouse gases and climate change	• Generation of greenhouse gases from operation of plant and equipment. • Loss of greenhouse sink as a result of vegetation clearance.	Minor	Likely	4	Section 17.5	Effective	**2**	6

Environmental issues		Assessment of potential impacts			Assessment of proposed mitigations			
Aspects	**Potential impacts**	**Overall consequence**	**Overall likelihood**	**Risk rating**	**Proposed mitigation measures**	**Effectiveness**	**Factor**	**Residual risk rating**
Pipeline operation								
Biodiversity (Ecology)	• Fragmentation of habitat. • Poor regeneration of native species. • Establishment and spread of weeds to environmentally sensitive areas. • Ongoing edge effects from maintenance of pipeline easement.	Moderate	Likely	3	Chapter 9	Very effective	3	6
Aboriginal heritage	• Adverse impacts on Aboriginal items and objects.	Major	Very unlikely	4	Section 10.1	Very effective	3	6
Historical heritage	• Adverse impacts on historical heritage sites.	Moderate	Very unlikely	4	Section 10.2	Very effective	3	6
Noise and vibration	• Disturbance to local residents and other land users. • Disturbance to stock and wildlife.	Minor	Unlikely	5	Section 11.3	Very effective	3	6
Traffic and transport	• Disruption of traffic and transport services through maintenance traffic.	Minor	Very unlikely	6	Section 11.5	Very effective	3	6
Air quality	• Release of gas. • Temporary reduction of amenity associated with dust.	Minor	Very unlikely	6	Section 11.4	Very effective	3	6
Socio-economic	• Temporary disruption to residents, landholders and third parties.	Minor	Very unlikely	6	Chapter 12	Very effective	3	6
Land use	• Adverse impact on current and potential future uses of land. • Damage to agricultural production or other land uses. • Reduced primary industry productivity and produce quality.	Moderate	Unlikely	4	Chapter 13	Very effective	3	6

Environmental issues		Assessment of potential impacts			Assessment of proposed mitigations			
Aspects	**Potential impacts**	**Overall consequence**	**Overall likelihood**	**Risk rating**	**Proposed mitigation measures**	**Effectiveness**	**Factor**	**Residual risk rating**
Hazards and risks	• Damage to property or human health resulting from an emergency incident. • Seismic event resulting in damage to the pipeline.	Catastrophic	Very unlikely	3	Chapter 14	Very effective	3	6
Surface and groundwater	• Adverse impacts on surface and groundwater quality. • Interruption to natural surface and groundwater flows. • Adverse impacts of waterway morphology.	Minor	Unlikely	5	Chapter 15	Effective	2	6
Infrastructure	• Disruption to services (rail, road, electricity etc) as a result of emergency maintenance activities.	Major	Very unlikely	4	Chapter 16	Very effective	3	6
Waste	• Adverse impacts on land resources due to excess waste sent to landfill.	Insignificant	Very unlikely	6	Section 17.1	Very effective	3	6
Contamination	• Contamination of land and water through spills of fuels or chemicals.	Minor	Very unlikely	6	Section 17.2	Effective	2	6
Geology and soils	• Soil compaction, erosion and sediment releases to land and water. • Subsidence of pipeline trench.	Moderate	Unlikely	4	Section 17.3	Effective	2	6
Visual amenity	• Emplacement of pipeline line of sight markers. • Permanent above ground infrastructure. • Cleared easements through forested areas.	Moderate	Unlikely	4	Section 17.4	Effective	2	6
Greenhouse gases and climate change	• Emission of greenhouse gases.	Major	Very unlikely	5	Section 17.5	Very effective	3	6

8.2.3 Outcomes of environmental risk assessment

Key issues

The environmental risk assessment did not identify any items of high residual risk during the pipeline construction and commissioning phase. All operational activities were assessed as having a low level of residual risk.

The environmental risk assessment identified nine items during the pipeline construction and commissioning phase as posing a medium level of residual environmental risk. Based on the outcomes of the environmental risk assessment, and following consideration of the issues raised in consultation with government agencies and relevant stakeholders as outlined in Chapter 6, historical heritage was added to the key issues for assessment. Therefore, the key environmental issues identified for assessment were:

- Biodiversity (Ecology).
- Aboriginal heritage.
- Historical heritage.
- Human amenity[1] (including aspects of noise, vibration and blasting, traffic and transport and air quality)
- Socio-economic.
- Land use.
- Hazards and risks.
- Surface and groundwater.
- Infrastructure.

Key issues are considered in Chapters 9 to 16 and the approach to their assessment is discussed in Section 8.3.

Other issues

Other issues are considered to be those that are normally associated with the development and delivery of pipeline proposals. Following consideration of the issues raised in consultation with government agencies and relevant stakeholders as outlined in Chapter 6 and the environmental risk assessment, the other environmental issues for the proposal were considered to be:

- Waste and resource management.
- Contamination.
- Geology and soils.
- Visual amenity.
- Greenhouse gases and climate change.

These issues are addressed in Chapter 17 and the approach to their assessment of other issues is discussed in Section 8.3.

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[1] Human amenity impacts was identified as a key issue in the DGRs, comprising noise, vibration and blasting, traffic and transport and air quality. These issues were treated separately within the environmental risk assessment.

8.3 Assessment approach

The assessment approach has been informed by available desktop information. The aim has been to develop an understanding of the key features of the existing environment and the potential impacts on any aspects of the receiving environment from the construction and operation of the proposal.

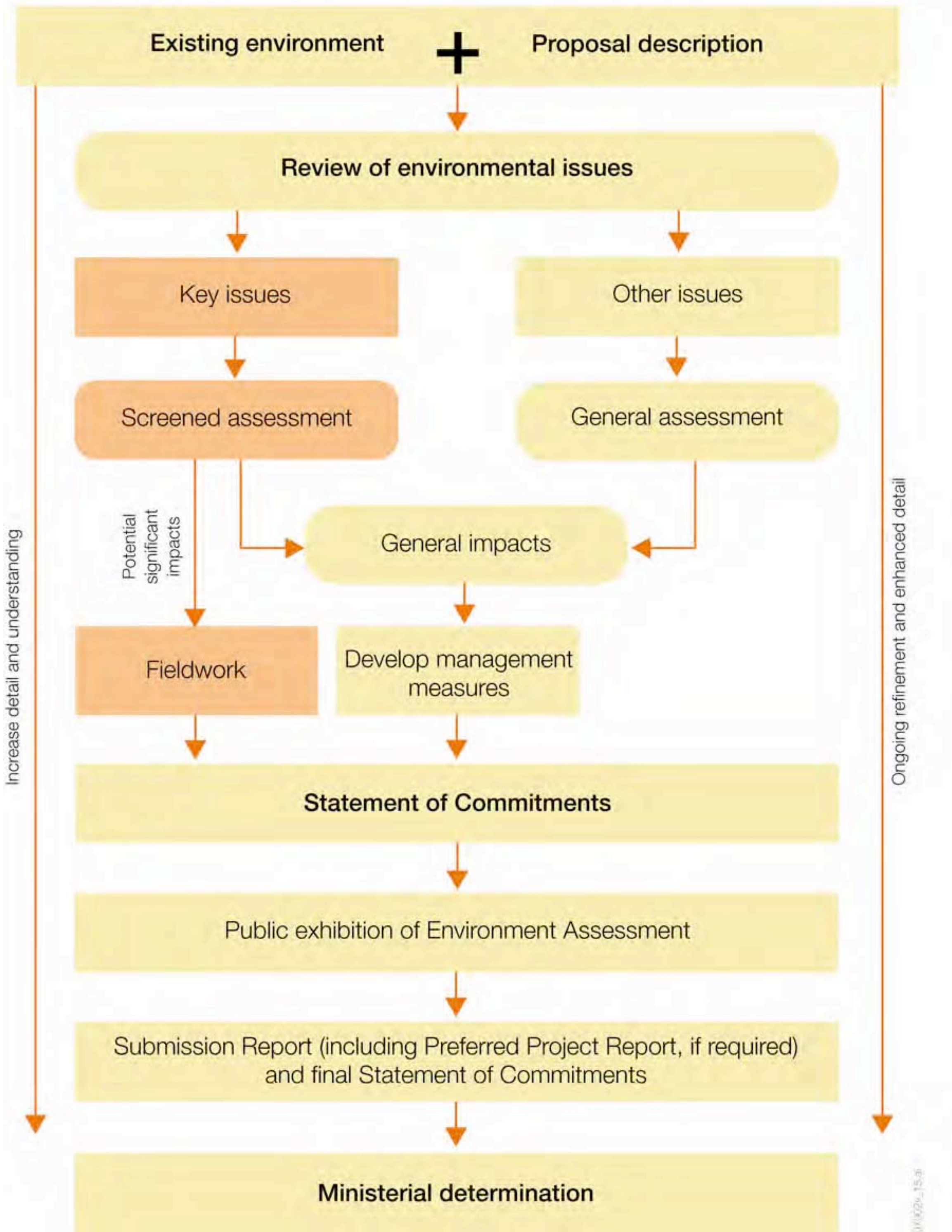
The overriding objectives of this EA are to identify, as far as possible:

- The issues and areas likely to provide substantial constraints and therefore require detailed field investigation during the ongoing refinement of the proposal and/or the preparation of issue or area specific management and mitigation strategies.
- The issues and areas that can be managed by pipeline industry standards and widely accepted management approaches.

Different approaches have been taken to assess the potential impacts on key issues and other issues and this is described in the following sections.

Given the desktop nature of the assessment, and the strategic framework of this report, certain issues remain unresolvable in definitive terms. For this reason, the EA has deliberately adopted a precautionary approach, whereby any issues that are sufficiently unclear and/or may result in potential impacts of significance have been identified for more detailed (field focused) investigations. The commitments relating to areas or issues that require field investigation are presented in Chapter 19. An overview of the EA process undertaken in this EA is provided below in Figure 8.1.

Figure 8.1 Overview of the environmental assessment process



Part B

8.3.1 Assessment of key issues

Key issues identified through the environmental risk analysis have been subjected to a tiered assessment of impacts. This provided for a more focussed and efficient environmental assessment.

The overriding objective of the tiered assessment process was to utilise a standardised and consistent approach in evaluating potential impacts along the entire length of the proposal.

In order to assess potential impacts, the tiered methodology utilised a set of tailored significance criteria for each key issue. The significance criteria were derived based on the extent to which an environmental attribute deviates from the normal baseline situation. Residual impacts were then assessed according to the significance criteria to identify those areas where:

- Fieldwork would be required – to enable a more informed understanding of environmental constraints and/or potential impacts as part of an adaptive management strategy outlined in Chapter 18.
- Standardised management approaches could be adopted.

Chapters 9 to 16 detail the tiered assessment methodologies specific to each key issue and those areas that are of potentially significant impact specific to the key issue.

8.3.2 Assessment of other issues

Other environmental issues were considered to be those that can be routinely managed through detailed design and by the implementation of standard management and mitigation measures aimed at ensuring that all necessary environmental criteria and guidelines are achieved.

The objective of the assessment of other issues was to focus on the development of overarching environmental management frameworks for mitigation, management and monitoring.

9 Biodiversity

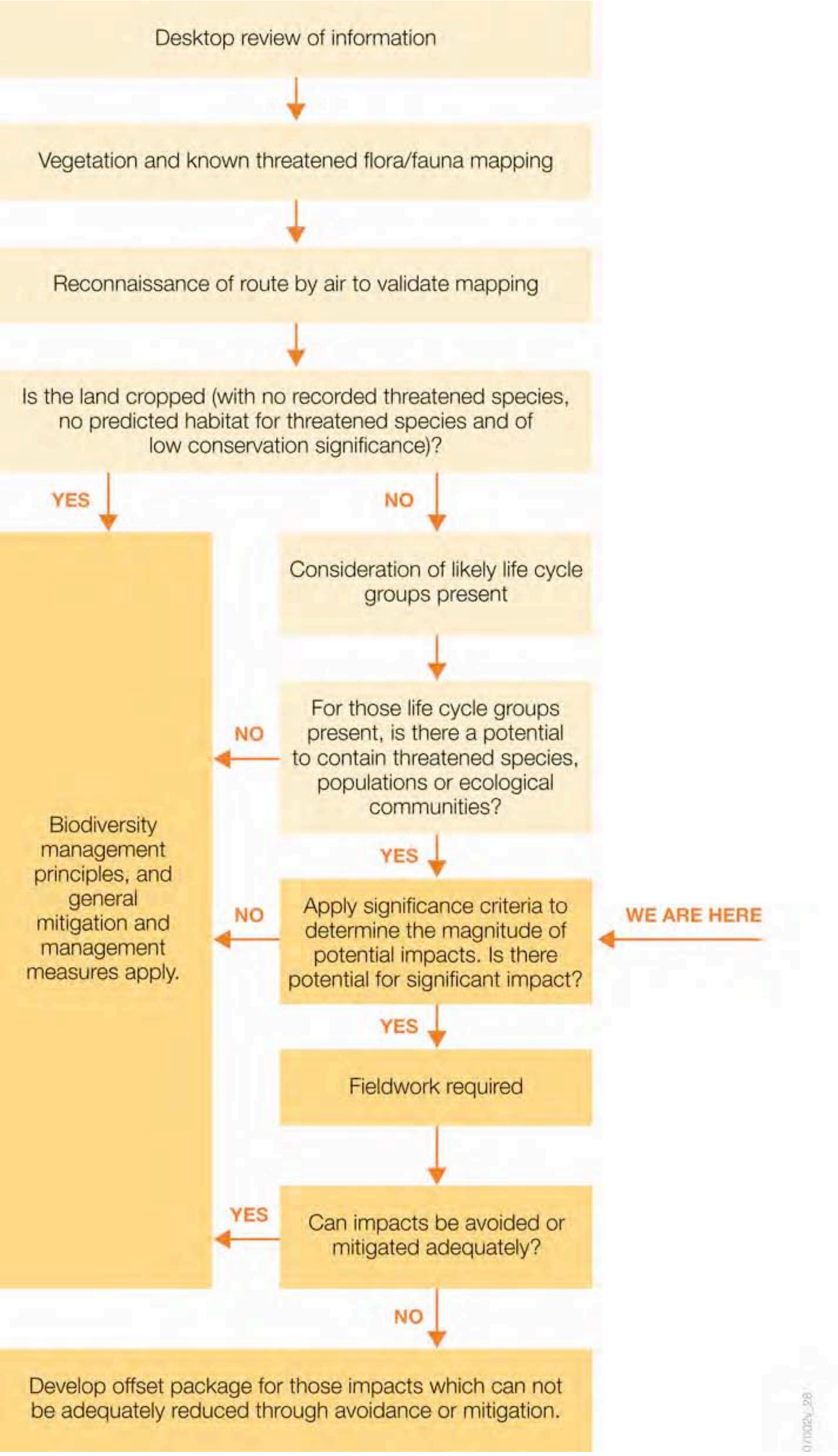
Chapter 9 provides an assessment of the potential impacts to biodiversity associated with the construction and operation of the proposal as well as measures that have been recommended to avoid or minimise the assessed impacts.

9.1 Assessment methodology

The biodiversity assessment undertaken for the EA was designed to strategically assess the potential impacts of the proposal on native vegetation, threatened species, populations, ecological communities and their habitat. Given the size of the proposal, the assessment adopted a tiered approach, where screening was conducted of biodiversity features based on ecological significance and the potential for impact as a result of the proposal. This approach allowed a specific assessment focus on biodiversity features with high ecological significance and potential for significant impact, with a more generalised assessment of other biodiversity features. In the context of the EA, this screened assessment approach also facilitated the ongoing refinement of the proposal, in accordance with a philosophy of impact avoidance on ecological value of high significance, and continual adaptive management.

The assessment methodology comprised two distinct phases of desktop review and research supported by aerial field validation, followed by an analysis of data and impact screening assessment, as outlined in Figure 9.1 and described in more detail following.

Figure 9.1: Biodiversity assessment approach



9.1.1 Desktop review and aerial reconnaissance

The primary objective of the first phase in the assessment was to identify, through a desktop review, any areas that may potentially pose biodiversity constraints for the proposal, and then to confirm or refute these constraints with a level of field validation by aerial reconnaissance. The desktop review undertaken for the proposal focussed on the 200m Study Area, incorporating a review of relevant literature, previous studies, interpretation of aerial photos, and other available biodiversity data from various GIS sources. In addition, the desktop review determined the relevant subject species that may be impacted by the proposal, which was then considered in more detail within the assessment.

The data sources used for the development of the subject species (DECC Atlas of NSW Wildlife, EPBC Protected Matters Search Tool, and CMA sub-region data) looked at a minimum area 10km either side of the Study Area. In some areas, owing to the poor quality of data, the lack of previous impact assessment documentation, and where the homogeneity of the landscape permitted, searches extended beyond 10km to provide a greater regional snapshot of the biodiversity conditions of the existing environment. Furthermore, detailed habitat and lifecycle requirements for all potentially occurring threatened species have been considered in the process of determining where these species may occur. Species included in the lists were also based on discussions with other ecologists involved in recent surveys in areas, where survey results are not necessarily available in the DECC Wildlife Atlas data at the time of completing this assessment. CMA sub-regions were also searched.

Following the desktop review, an aerial reconnaissance was undertaken to validate the desktop data. The aerial reconnaissance was particularly focussed on assessing the extent and potential condition of areas within the Study Area containing native vegetation (as a proxy for biodiversity values), while at the same time identifying areas that may have been subject to varying degrees of historical land use disturbance. This risk based approach allowed the validation of sections of the Study Area that do not contain native vegetation and therefore provides confidence that these are lower risk areas[1]. In these areas, the adoption of mitigation and management measures in conjunction with an adaptive management approach would ensure impacts are negligible.

The desktop review relied on a number of key vegetation mapping assessments, and other data sources which vary in quality, currency and reliability. The EA recognises that there are a number of regions within the Study Area where existing threatened species information is poor. In managing these data limitations, the EA enhanced search areas and using the experience of the ecology specialists engaged for the assessment, judiciously added species otherwise not turned up through desktop searches to be considered through the screening assessment. In addition those areas identified and subject to additional fieldwork will be investigated in a measured approach. This approach not only seeks to assess subject species, but also conduct more general habitat analysis to ensure that any other species not identified as target species for further investigation and/or identified through the desktop review process can also be accommodated within the adaptive management approach proposed. The limitations of the data and methodology are further discussed in Chapter 3 of the specialist biodiversity assessment that is included in Appendix D.

[1] It should be noted that although native vegetation condition and extent was used as one of the proxies for biodiversity value, areas with limited native vegetation, or poor quality vegetation can still occasionally provide habitat for threatened species. For this reason, a precautionary approach was used that also identified the potential for certain threatened species within areas where other indicators (previous records, or other preferred habitat components like rock outcrop or permanent water bodies) suggested that these species could be present.

9.1.2 Data analysis and impact screening assessment

The subject species determined through the initial desktop phase of the assessment were then considered in terms of the potential for significant impacts from the proposal, taking into account the conservation status of the native vegetation, threatened species, populations, ecological communities and their habitat. The significance of impacts on biodiversity features was undertaken through a screened assessment approach, using the significance criteria outlined in Table 9.1 below. The screening assessment is based on the principles of both the seven-part test (Section 5A of the EP&A Act), as well as the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines. For the purposes of the assessment, lifecycle[2] groups were developed to group all target species into simple units for consideration.

Table 9.1 Biodiversity impact significance criteria

Significance criteria[3]	
Significant	**Not significant**
Threatened flora and fauna	
• Have an adverse effect on the lifecycle of a viable local population and place it at risk of extinction. • Fragmentation or isolation of habitat from other areas of habitat to a level that would impact on a viable population. • Remove a significant area of habitat.	• Unlikely to impact on the lifecycle of a viable population. • Unlikely to fragment or isolate habitat from other areas of habitat.
Endangered populations	
• Have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	• Unlikely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Endangered ecological communities or critically endangered ecological communities	
• Work that is likely to place a local community at risk of extinction. • Work that 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.	• Work that is unlikely to place a local community at risk of extinction.
Rare or threatened Australian plant (ROTAP) species, biogeographical forest ecosystems and other protected species	
• Work likely to place a local forest ecosystem, ROTAP species or protected species at a risk of extinction.	• Works would have only a minimal impact on attribute.

[2] *A lifecycle group is defined as a group of organisms with similar lifecycle attributes and ecological requirements.*

[3] *For the purposes of this criteria, 'local' is determined during the assessment based on the habitat, lifecycle, and/or distribution for each relevant species, community or population.*

Initially, areas along the proposal that comprised grazing land, cropping or ploughed land, or scattered trees with no records or potential for threatened species, populations or communities, were identified as low risk areas. In these areas the implementation of mitigation measures and an overarching adaptive management approach would assist in ensuring that impacts are not likely to be significant. The potential for adverse impacts in these areas would be managed via the implementation of mitigation and management measures as outlined in Table 9.5.

For other sections of the proposal, the above significance criteria were applied to the following lifecycle groups:

- Woodland and forest birds, hollow dependent birds and ground dwelling birds.
- Burrowing amphibians.
- Non-burrowing amphibians.
- Saxicolous (rock dwelling) reptiles.
- Fossorial (burrowing) reptiles.
- Arboreal mammals.
- Terrestrial mammals.
- Wetland birds.
- Aquatic fauna.
- Other hollow dependent fauna.
- Endangered ecological communities and threatened flora species.

Given the specific habitat requirements for fish, a modified assessment approach was undertaken whereby background searches for fish species potentially occurring within 50km of the proposal was undertaken, in order to account for fish migrations, and compensate for known limitations in the data. The subject species occurring within the three catchments of the Central-Hunter, Namoi and the Border Rivers/Gwydir were then assessed against the same criteria as outlined above.

The outcomes of this screening process were a determination of:

- Potentially significant biodiversity risk areas, where the results of fieldwork (currently in progress) will be used to guide the ongoing refinement of the ROW, the development of specific avoidance and management and mitigation measures, and as necessary a biodiversity offset package.
- Other areas where it is expected that, given implementation of best practice environmental mitigation and management measures, potential impacts could be reduced to an acceptable level.

9.2 Existing environment

The proposal passes through a diverse range of vegetation and habitat types from south central Queensland semi-arid lands to coastal hinterland environments near Newcastle on the NSW coast. Given the large number of species, populations and communities the proposal may interact with, the full list is not reproduced here and therefore included in Appendix 2 of the biodiversity assessment, which is located in Appendix D of the EA. Accordingly, the information presented below focuses on those species, lifecycle groups, populations and communities, which after being considered in the context of the screening process outlined in Section 9.1 may experience potentially significant impacts. Consequently, more detailed investigations to refine the ROW alignment and develop management and mitigation measures to reduce any adverse impacts to an acceptable level would be required.

9.2.1 Endangered populations

There are five endangered populations of flora known to occur within the vicinity of the Study Area. Of these, the Pine Donkey Orchid (*Diuris tricolor*) population in the Muswellbrook LGA, the commonly known Tiger Orchid (Harden 1993) or Black Orchid (Bishop 1996) (*Cymbidium canaliculatum* R. Br.) population in the Hunter catchment, and the River Red Gum (*Eucalyptus camaldulensis* Dehnh.) population in the Hunter catchment are expected to occur within the Study Area.

The Australian Brush-Turkey population, Nandewar and Brigalow Belt South bioregions – endangered population listing could occur along the northern section of the Study Area from Moree to Narrabri.

9.2.2 Endangered ecological communities

Twenty-two endangered ecological communities (EECs) were identified with the potential to occur along the length of the proposal. Appendix 2 of the biodiversity assessment provides a full list of all EECs with a description of each and likelihood of occurrence and impact. As a result of the screening process those that are expected to occur within the Study Area and have the potential to be impacted have been described below.

- *Native vegetation on cracking clay soils of the Liverpool Plains* (TSC Act). This community is likely to occur around KP446-450 and KP465-468 and in scattered patches further south.
- *Swamp oak flood plain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* (TSC Act). This community is present within or adjacent to the Study Area, especially from the Hunter estuary to Hunter River crossing.
- *Swamp sclerophyll forest on coastal flood plains of the NSW North Coast, Sydney Basin and South East Corner bioregions* (TSC Act). This community occurs near the Pacific Highway at around KP 813.
- *Freshwater Wetlands on Coastal Flood plains of the NSW North Coast, Sydney Basin and South East Corner bioregions* (TSC Act). This community is present mostly in association with the Hunter River estuary at the southern end of the proposal.
- *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin bioregion* (TSC Act). This community could occur in areas mapped as Grey Box-Red Gum-Ironbark and Ironbark, as well as Hunter Spotted Gum-Ironbark.
- *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains bioregions Brigalow* (*Acacia harpophylla* dominant and co-dominant) (TSC and EPBC Act). This community is present along the proposal with known stands at KP490, KP466, KP460 and KP453.
- *Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South bioregions* (TSC Act). It is possible that this community occurs along the proposal.
- *Coolibah Black Box woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions* (TSC Act). This community is present along the Study Area in fragmented stands from an area south of Garah North to the Queensland Border.
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* (TSC Act). The EEC is present along the edges of some stands of fragmented vegetation at KP275 and KP296.

- *Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South bioregions* (TSC Act). This community is present at KP251 on the edge of the TSR.
- *Bluegrass (Dichanthium spp.) dominant grasslands of the Brigalow Belt bioregions (north and south)* (EPBC Act). This EEC may occur within vegetation stands mapped as 'native and naturalised grasslands/chenopods', 'Moree grassland' and 'northern clay plain grassland'.
- *White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Grassland* (TSC Act and EPBC Act). Within the Study Area, stands may occur in vegetation mapped as New England Stringybark, Yellow Box-Blakely's Red Gum, Yellow Box-Broad-leaved Stringybark, Yellow Box-Grey Box-Red Gum, New-England Stringy Bark-Blakely's Red Gum, Yellow Box/Blakely's Red Gum/Rough-barked Apple, or Yellow Box/Blakelys Red Gum/Grey Box. The aerial reconnaissance in conjunction with the vegetation mapping indicates that these communities could occur within the pipeline route at KP641, 660, 662, and 668-669. It should be noted that the air reconnaissance confirmed that some of these stands had been cleared despite being mapped stands.

The presence of EECs is further developed in the biodiversity constraint mapping for the proposal, to show the presence of EECs for each KP section of the proposal, in Chapter 18.

9.2.3 Threatened flora

A threatened flora species list was generated from DECC Wildlife Atlas records within 10km of the Study Area. In addition an assessment of species whose habitat may be present along or adjacent to the Study Area was undertaken. Table 9.2 lists those threatened species likely to be present within the Study Area and with the potential to be adversely impacted by the proposal. Those species, which after the screening process described in Table 9.1 have the potential to be significantly impacted, are annotated with an *.

Table 9.2 Threatened flora species likely within the Study Area

Species	Listing
*Sida rohlenae**	TSC Act (e)
*Digitaria porrecta**	TSC Act (e) EPBC Act (e)
*Zannichellia palustris**	TSC Act (e)
*Bothriochloa biloba**	EPBC Act (v)
Tylophora linearis	TSC Act (e) EPBC Act (e)
Tetratheca juncea	TSC Act (v) EPBC Act (v)
Rhizanthella slateri	TSC Act (v) EPBC Act (e)
Philotheca ericifolia	TSC Act (v) EBPC Act (v)
Lepidium monoplocoides	TSC Act (e)
Desmodium campylocaulon	TSC Act (e)
*Dichanthium setosum**	TSC Act (v) EPBC Act (v)
*Diuris tricolor**	TSC Act (v) EPBC Act (v)
*Swainsona murrayana**	TSC Act (v) EPBC Act (v)
*Eucalyptus parramattensis subsp. decadens**	TSC Act (v) EPBC Act (v)
Homopholis belsonii	EPBC Act (v)

Part B

Species	Listing
Thesium austral	TSC Act (v) EPBC Act (v)
Goodenia macbarronii	TSC Act (v)
Prostanthera cineolifera	TSC Act (v) EPBC Act (v)
Cyperus conicus	TSC Act (e)
Monotaxis macrophylla	TSC Act (e)
Pomaderris queenslandica	TSA Act (e)

Key: v – vulnerable, e – endangered

9.2.4 Threatened fauna

The proposal would pass through habitat for the following general fauna lifecycle groups, which through the screening process have been determined to potentially contain one or more representative threatened species with potential for significant impact.

Woodland and forest birds, hollow dependent birds, ground dwelling birds

Riparian vegetation and flood plain woodland along major watercourses such as the Namoi and Mehi Rivers. Smaller riparian areas along creek lines such as Gil Gil, Mooki, Marshalls Ponds and Tycannah Creeks. Woodland areas adjacent to the Boomi River comprising Coolibah. Other woodland areas including conservation reserves and TSRs around the Namoi Valley, Liverpool Plains and ranges.

Non-burrowing amphibians

Known records are predominantly in wetland areas around the Hunter River-Hexham area and Kooragang Nature Reserve. Habitat would also occur on watercourse and wetlands across the Study Area, in particular around the Boomi, Gnoura Goura, Gil Gil, Gwydir, Mooki and Mehi drainage systems.

Saxicolous (rock dwelling) reptiles

Rocky outcrop areas adjacent to the Namoi River near Baan Baa and the New England Highway south of Murrurundi. Potential movement corridors between rocky outcrop areas/ridges around the Wingen and Elderslie areas.

Fossorial (burrowing) reptiles

Rocky outcrop areas (as for saxicolous reptiles) in addition to Coolibah/Blackbox Woodland, riparian vegetation, native and naturalised grassland areas and native vegetation on cracking clay soils. Within these areas fossorial reptiles could be present within cracks in the soil as well as beneath dead timber and leaf litter.

Arboreal mammals

Woodland areas and corridors, particularly riparian vegetation along major watercourses such as the Namoi, Mehi and Hunter Rivers as well as smaller creeks throughout the Study Area. TSRs and conservation reserves within the Namoi Valley and Liverpool Ranges.

Terrestrial mammals

Woodland areas and corridors particularly where wooded fragments are located close to a water source and where native grasses are present. TSRs and conservation reserves within the Namoi Valley and Liverpool Ranges.

Wetland birds

Wetland or low lying areas around the Hunter River area including the Hexham Swamp Nature Reserve and Kooragang Nature Reserve.

Fish

All watercourses including permanent and ephemeral waterways particularly where snags and riparian vegetation are present.

Hollow dependent fauna

Woodland areas and corridors particularly where wooded fragments are located close to a water source, and contain remnant vegetation of sufficient age to support hollows.

Within these fauna lifecycle groups, the following threatened species were identified from the screening assessment process, with a potential to be significantly impacted by the proposal. The species are also the subject of fieldwork designed to influence the ROW alignment during detailed design, and the adaptive management of the proposal during construction.

Table 9.3 Fauna species and groups with potential for significant impacts

Species	Conservation listing
Border Thick-tailed Gecko	TSC Act (v)
Five-clawed Worm-Skink (Long-legged Worm Skink)	TSC Act (e) EPBC Act (v)
Pink-tailed Worm-lizard	TSC Act (v) EPBC Act (v)
Green and Golden Bell Frog	TSC Act (e) EPBC Act (v)
Koala	TSC Act (v)
Striped-faced Dunnart	TSC Act (v)
Pilliga Mouse	TSC Act (v) EPBC Act (v)
Pale-headed Snake	TSC Act (v) EPBC Act (v)
Micro Bats	Various[4]
Regent Honeyeater	TSC Act (e) EPBC Act (e)
Superb Parrot	TSC Act (v) EPBC Act (v)
Australian Bustard	TSC Act (e)
Mallee Fowl	TSC Act (e) EPBC Act (v)
Brown Treecreeper (eastern subspecies)	TSC Act (v)
Turquoise Parrot	TSC Act (v)
Grey-crowned Babbler (eastern subspecies)	TSC Act (v)
Speckled Warbler	TSC Act (v)
Diamond Firetail	TSC Act (v)
Squatter Pigeon	TSC Act (v) EPBC Act (v)
Australian Brush-Turkey population in the Brigalow Belt South (endangered population)	TSC Act (v)
Terek Sandpiper	TSC Act (v) EPBC Act (v)
Lesser Sand Plover	TSC Act (v) EPBC Act (v)
Black-tailed Godwit	TSC Act (v) EPBC Act (v)
Broad-billed Sandpiper	TSC Act (v) EPBC Act (v)
Little Tern	TSC Act (e)

[4] *'Various' indicates that this faunal group contains a number of species subject to conservation listings as threatened under both the EPBC and TSC Act.*

Species	Conservation listing
Black-necked Stork	TSC Act (e)
Painted Snipe	TSC Act (e) EPBC Act (v)
Squirrel Glider	TSC Act (v)
Eastern Pygmy Possum	TSC Act (v)

Key: v – vulnerable, e – endangered

9.2.5 Aquatic ecology

The surface and groundwater assessment presented in Chapter 15, identified a number of watercourses where further investigations may be required in order to determine the most appropriate crossing location and crossing methodology to be employed during construction of the proposal. These high sensitivity watercourses, described in Appendix K, also provide important habitat for EEC and endangered aquatic species including:

- Lowland Darling River aquatic ecological community.
- *Notopala sublineata* (River snail).
- *Bidyanus bidyanus* (Silver perch).
- *Ambassis agassizii* (Olive perchlet) western population.
- *Mogurnda adspersa* (Purple spotted gudgeon) western population.
- *Maccullochella peelii peelii* (Murray Cod).

9.3 Potential impacts

The proposal has the potential for direct and indirect impacts on biodiversity. The survey methodology and more detailed assessment of potential impacts of the proposal are included in Appendix D and have been summarised below. The potential impacts from the proposal have been categorised into construction impacts and operational impacts and developed in consideration of the significance criteria outlined in Section 9.1. Further investigations would serve to inform the identification of key populations and therefore impacts. Reference should therefore also be made to Section 9.5.

9.3.1 Construction

During the construction phase vegetation would need to be removed in a number of areas to create the ROW. During construction there is a potential to spread the distribution of weeds species, and thereby contribute to the degradation of local habitats. Soil erosion, runoff and sedimentation would also have the potential to degrade local water quality and impact on the quality of aquatic habitats. There is also potential for disturbance to fauna as a result of construction noise and vibration.

General

A number of key threatening processes relate to the spread of weeds into areas of native vegetation, including:

- Invasion and establishment of exotic vines and scramblers.
- Invasion of native plant communities by bitou bush and boneseed.
- Invasion of native plant communities by exotic perennial grasses.

- Invasion, establishment and spread of *Lantana camara*.

The proposal would have the potential to facilitate the spread of weeds without proper management measures in place. For this reason, weed management would be an important component of environmental management during detailed design, and throughout the construction and operation phase of the proposal. Weed management measures will be prepared as part of the CEMP for the proposal, using information collected through field surveys, literature and database review in addition to consultation with landowners regarding known weeds and existing onsite management arrangements. The CEMP would include identification of areas of noxious weeds and management measures to ensure weeds are not spread; measures to minimise weed risks, weed control (including prior to commencement of works), weed hygiene and rehabilitation.

There is potential for the proposal to spread the soil borne pathogen Cinnamon Fungus (*Phytophthora cinnamomi*). The pathogen occurs widely across Australia but the severity of its impact is most evident within ecological communities of the south west and south east of the country. However, options for the control of the disease are limited (Cahill *et al*, 2008). The disease is recognised at a Commonwealth level as a threat to Australia's biodiversity. Management of the disease is reliant on hygiene, the use of chemicals and restriction of access, and has had only limited effectiveness and not provided complete control (Cahill *et al*, 2008).

Accordingly, a risk assessment will be undertaken prior to any disturbance as a result of pipeline activities to determine the likelihood of occurrence within the ROW. The results of the risk assessment will be included in the CEMP. Where risks are identified, appropriate measures would be developed and detailed in the CEMP. This would include measures such as restriction of vehicle movements and hygiene controls as necessary.

EECs and threatened flora

The conservation value of the vegetation was considered in the proposal design and route selection. The 200m Study Area within which the 30m ROW would be aligned has been located to minimise removal of remnant vegetation and utilises existing cleared lands wherever possible. This was achieved through the drive-by reconnaissance undertaken by engineers responsible for the selection of the Study Area (200m), referred to in Chapter 3. However, the proposal would likely include the removal of some vegetation, and would therefore result in an increase in isolation and fragmentation of some vegetation communities within the ROW.

Table 9.4 presents a summary of this information outlining the linear extent of potential EECs within the Study Area. It should be noted that this is the potential maximum length as EECs may not be present for the entirety of the kilometre, ie this is a conservative representation of the potential impacts.

Table 9.4 Linear extent of potential EECs and other flora within the Study Area

Biodiversity Features	Potential length of pipeline affecting community or flora species (km)
Coolibah-Black Box Woodland of the Northern Riverine Plains in the Darling Riverine Plains and Brigalow Belt south bioregions (TSC Act)	21
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains bioregions TSC and EPBC Act)	4
Bluegrass Dominant Grasslands of the Brigalow Belt bioregions (EPBC Act)	9
Freshwater Wetlands on Coastal Flood plains of the NSW North Coast, Sydney Basin and South East Corner bioregions (TSC Act)	24
Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin bioregion	3

Biodiversity Features	Potential length of pipeline affecting community or flora species (km)
(TSC Act)	
White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Grassland (TSC Act and EPBC Act)	4
Native Vegetation on Cracking Clay Soils of the Liverpool Plains (TSC Act)	12
Swamp Oak Forest[5] (TSC Act)	24
Combined threatened flora species, including endangered populations (EPBC and TSC Act)	127

The maximum total linear length of the Study Area that potentially contains EEC is 73km. This represents 12 per cent of the Study Area. It should be noted however, that the extent and conditions of identified EECs are subject to further investigation, as outlined in Section 9.5. It should be noted that avoidance would continue to be the preferred means of selecting the final ROW, which at 30m represents 15 per cent of the width of the Study Area.

Threatened fauna

Potential habitat for threatened fauna within the Study Area is generally characterised by isolated fragments of vegetation and habitat features within a landscape that has been subject to varying degrees of historical disturbance for the purposes of agriculture, grazing and other land uses. Potential habitat in the form of woodlands, rocky outcrops, riparian areas, grassland and pasture would potentially be impacted by the proposal if not avoided by the ROW alignment.

Hollow bearing trees are likely located within the Study Area and represent important roosting, breeding and nesting resources for a number of fauna species, including woodland birds, hollow dependent fauna and arboreal mammals. Where the proposal passes through a potential woodland bird movement corridor, construction impacts may result in disruptions to dispersal movements along corridors, which are often the only means of dispersal through fragmented landscapes. In addition a number of threatened bird species identified in Table 9.3 are known to spend a large part of their lifecycle on the ground, and therefore could be impacted during construction activities.

Potential habitat has been identified for threatened reptile species including the Border Thick-tailed Gecko, the Long-legged Worm Skink and the Pink-tailed Worm Skink. Wherever possible the ROW would be aligned to avoid any areas of identified habitat within the Study Area, however where avoidance is not possible, the proposal would result in the removal of habitats, and would have adverse impacts on the lifecycle of these species.

The Study Area also includes areas of potential habitat for small ground dwelling mammals, particularly in areas north of KP454. Species from this lifecycle group are known to occur within a small home range, and therefore any potential impacts to habitat would likely be significant.

5 Swamp Oak Forest represents both the Swamp oak flood plain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and the Swamp sclerophyll forest on coastal flood plains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Potential Koala habitat has been identified within the Study Area although it is not clear whether this potential habitat would represent core Koala habitat, within the meaning of *SEPP44 – Koala Habitat Protection*. Potential impacts to Koalas would arise from the removal of habitat, and in particular known feed tree species.

The Study Area also passes through a number of locations identified as known habitat for the Green and Golden Bell Frog. Mortality from construction activities, the introduction of the Cinnamon Fungus, and the disturbance to habitat are generally key threats for this species. Within the vicinity of Kooragang Island, some land is already identified as Green and Golden Bell Frog habitat offset areas for approved or proposed development. The proposal would avoid these areas by aligning the ROW wholly within the infrastructure corridor identified for the Tomago Industrial Site refer to Map 8 of Schedule 3 of SEPP (Major Projects) 2005.

Endangered aquatic communities and threatened fish

Potential impacts of construction activities on endangered aquatic communities and threatened fish include:

- Disturbance to habitat associated with the crossing of watercourses as described in Chapter 15.
- Removal of riparian vegetation.

Potential indirect impacts during construction works include:

- Temporary barriers to fish passage resulting in potential disruption to breeding and migration.
- Temporary reduction of water quality.
- Temporary degraded water quality and sedimentation of downstream areas with consequent potential adverse impacts threatened fish species.
- Increased erosion due to increased flows and vegetation clearance.

9.3.2 Operation

During the operation of the proposal, increased edge effects and fragmentation of vegetation communities could occur. Although there would be no physical barriers to restrict movement of fauna, the need to maintain a cleared drive-line within the Study Area could impact adversely on some species, when habitat becomes fragmented. Edge effects could also result in further reduction in the environmental quality of vegetation and associated habitat.

EECs and threatened flora

Potential impacts to the EECs and threatened flora within the Study Area as a result of the operation of the proposal would be confined to increased weed invasion due to edge effects or uncontrolled runoff.

Threatened fauna

Potential impacts on threatened fauna species during the operation of the proposal include:

- Increased fragmentation of habitat, in particular for small ground dwelling mammals, woodland birds, hollow-dependent fauna, ground-dwelling birds, and rock dwelling reptiles.
- Increases in weed invasion and hence quality of fauna habitat.

9.4 Proposed mitigation and management measures

The mitigation and management measures presented in Table 9.5 below have been developed with the aim of minimising or mitigating, as far as practical, the adverse impacts to biodiversity described in Section 9.3. The mitigation and management measures draw on industry best practice management as set out in the APIA Code, government standards and guidelines, legislative requirements and specialist knowledge. However, a number of the mitigation and management measures presented would apply only in the event that the relevant biodiversity features are present within or adjacent to the ROW. Targeted field investigations are noted in Table 9.5 and are further detailed in Section 9.5 as fieldwork requirements.

Table 9.5 Biodiversity mitigation and management measures

Potential Impacts	Mitigation and management measures
During construction	
Removal of Pine Donkey Orchid (*Diuris tricolor*) habitat in the Muswellbrook LGA population, River Red Gum, (*Eucalyptus camaldulensis* Dehnh.) habitat in the Hunter Catchment population, and the commonly known Tiger Orchid (Harden 1993) or Black Orchid (Bishop 1996) (*Cymbidium canaliculatum* R. Br.) population in the Hunter catchment.	• Confirm locations of these populations against relevant construction plans. • Avoid if possible. • Known areas or areas representing potential habitat should be fenced and protected during works. • In areas where impacts are unavoidable, and after the application of mitigation and management measures (including the narrowing of the ROW where technical and other environmental constraints allow) residual impacts are still likely; consider strategies for the suitable offset of impacts.
Removal of, and disturbance to EECs and threatened flora species, and disturbance to ecological function of the communities.	• Confirm the presence or absence of these EECs and threatened flora species through targeted field investigation of identified potential occurrence areas. • If the EEC or threatened flora species is present then confirm the extent and condition of the community with regard to the ROW alignment. • Where possible optimise the ROW alignment to avoid impacts on areas identified as EEC or habitat for threatened flora. • In areas where impacts are unavoidable, and after the application of mitigation and management measures (including the narrowing of the ROW where technical and other environmental constraints allow) residual impacts are still likely; consider strategies for the suitable offset of impacts.
Spread of Cinnamon Fungus	• Conduct a risk assessment prior to construction, to determine areas where Cinnamon Fungus may be present. • Engage with DECC and other relevant government agencies to aid in determining areas where risk of Cinnamon Fungus may be high. • As necessary develop mitigation and management measures, in line with available initiatives to restrict the spread of any incidences of Cinnamon Fungus.

Potential Impacts	Mitigation and management measures
Disruption to Green and Golden Bell Frog habitat and wetland bird species habitat	• Confirm through targeted investigation areas of actual and potential Green and Golden Bell Frog and listed wetland bird species habitat. • Where possible optimise the ROW alignment to avoid impacts on identified habitat areas. • Develop appropriate and site specific mitigation and management measures to reduce impacts on this species, including a consideration of lifecycle requirements and breeding times in planning construction timing.
Removal of potential habitat for threatened reptile species	• Inspect, by a qualified ecologist, areas of potential habitat for the Long-legged Worm Skink, Border Thick-tailed Gecko and the Pink-tailed Worm Lizard, prior to impacts from construction works. • If any Pink-tailed Worm Lizards, Long-legged Worm Skinks or Border Thick-tailed Geckos are identified, they would be removed by a qualified ecologist from the construction area to suitable adjacent habitat. • Retain suitable habitat features within ROW following construction.
Disturbance to areas of core Koala habitat	• Conduct detailed investigation of those areas identified as potential Koala habitat. • Should areas of core Koala habitat be identified, mitigation and management measures would be developed with consideration for any relevant, in force, Plans of Management, in accordance with *SEPP44 – Koala Habitat Protection*.
Disturbance to normal ecological function of ground dwelling mammals, including the removal of habitat	• Conduct targeted investigation of those areas identified as potential habitat for the Stripe-faced Dunnart and Pilliga Mouse. • Where possible optimise the ROW alignment to avoid impacts on identified habitat areas. • Develop appropriate and site specific mitigation and management measures to reduce impacts on this species, including a consideration of lifecycle requirements and breeding times.
Barriers to fish passage during pipeline installation across waterways	• Design of waterway crossings and structures would be undertaken with reference to the *Guidelines for Design of Fish and Fauna Friendly Waterway Crossings* (Fairfull and Witheridge 2003) and where necessary in consultation with DPI.

Removal of other native vegetation including loss of other sensitive fauna habitat	• Implement specific biodiversity mitigation procedures in areas identified as constraints on the biodiversity constraint mapping and in accordance with the principles of:
	  ◦ Avoidance.
	  ◦ Mitigation.
	  ◦ Offset, as a last resort.
	• Keep clearing of vegetation to the minimum necessary to construct the pipeline. Impacts would be avoided where possible and existing vegetation would be maintained where safety and design are not compromised.
	• As necessary, collect native seed prior to clearing, for use in the revegetation of disturbed areas.
	• Revegetate with endemic species, where possible, thereby increasing the habitat value and visual amenity of the area.
	• Plant a range of locally occurring native shrubs, trees and groundcover plants. Discussions would be held with the DECC regarding the choice of species, with preference given to those species characteristic of locally occurring EECs.

Potential Impacts	Mitigation and management measures
	• Maintain revegetation plantings for not less than two years and until revegetation has been successful. • Retain any transposable habitat features such as large logs and boulders in adjacent areas for reinstatement following construction to allow continuation as potential fauna refuge sites. • Revegetate areas disturbed during construction progressively.

Removal of habitat for hollow dependent fauna	• Where possible optimise or narrow the ROW to avoid hollow bearing trees.
	• Implement clearing protocols in identified sensitive woodland areas, which involve checking hollow-bearing trees for the presence of bird nests and arboreal animals such as possums, gliders, snakes and bats prior to felling or pushing. Animals found to be occupying trees would be safely removed before clearing of the trees. A qualified ecologist would relocate animals removed locally into nearby suitable habitat.
	• In identified sensitive woodland areas that may contain hollow bearing trees:
	  • A two stage clearing of vegetation and fauna habitats would be undertaken, so that non-hollow bearing trees would be felled first.
	  • All hollow-bearing trees to be felled would be clearly marked and catalogue species and approximate dimensions so that hollows or nest boxes can be fixed to similar standing trees.
	  • Hollows or nest boxes would be attached to trees with consideration of aspect, height and location appropriate for the targe fauna species.
	  • Salvaged sections of hollows or nest boxes would be attached to trees in a way that allows for tree expansion and does not detrimentally impact the tree.

Hydrological changes due to vegetation clearance, including decreased surface water quality	• In areas of highly erodible stream banks, revegetate riparian zones with species of local provenance to increase stability.
During operation	
Increased weed invasion due to edge effects	• Undertake ongoing management and monitoring of weed invasion for a period of no less than two years following completion of the construction phase.
Decreased surface water quality and reduction in quality of aquatic habitat	• Ensure that revegetation of riparian zones is effectively implemented with species of local provenance to stabilise soils and prevent erosion of stream banks.

9.5 Fieldwork

Given the nature of the EA, which has been informed largely by desktop information validated with aerial reconnaissance survey, the potential impacts in Section 9.3 have been presented in a precautionary manner. The current data on where EECs and/or threatened species habitat potentially occur presents coarse zones within the Study Area, defined to an accuracy of 1km. This information is presented as biodiversity constraints, and is further discussed in Chapter 18.

In order to ascertain if there is the potential to locally avoid sensitive areas through the ROW alignment, fieldwork is required to:

- Confirm the location, condition and extent of species, populations and communities.
- More accurately determine potential impacts, available options for the mitigation of adverse impacts, and the need or otherwise for any proposal wide compensatory measures.

This fieldwork is described in Chapter 18. It is being conducted during spring and will be available by the submissions report. As a result of this work, it is expected that a majority of adverse biodiversity impacts would be avoided through careful ROW alignment and the implementation of location specific biodiversity management measures through areas of identified sensitivity.

Although there exists a significant opportunity to further refine the ROW alignment and in doing so further reduce adverse impacts, it is expected that in some locations the removal of vegetation will be unavoidable. For this reason, a strategy would be developed to ensure that any such unavoidable native vegetation clearances would be suitably offset.

9.6 Offset strategy for residual impacts

Although the mitigation and management measures would generally be adequate for the likely impacts, there are some impacts where avoidance or mitigation may not be adequate. The following residual impacts could potentially result from the QHGP proposal:

- A loss of native vegetation, including vegetation from EECs.
- A loss of habitat for a variety of native fauna species.

To address the residual impacts of the proposal, QHGP would propose to implement a biodiversity offset strategy that would contribute to the long-term conservation of biodiversity. Pending the results of detailed biodiversity field investigations, and anticipated further consultation with relevant government agencies and stakeholders, the following table presents preliminary options for consideration. There may also be an opportunity for QHGP to utilise the newly commenced (July 2008) BioBanking Scheme administered by DECC in order to offset any residual impacts associated with the proposal.

Table 9.6: Preliminary options for consideration in a biodiversity offset package

Option	Discussion
Supplementary revegetation and enhancement of retained revegetation within the ROW	• If revegetation measures, as described in Chapter 5, are not adequate, QHGP could, where appropriate undertake supplementary revegetation within the ROW and in adjacent properties (with landholders consent within key residual biodiversity impact zones. • Revegetation could consist of plant species of local provenance (if available), selected in consultation with local landcare groups or similar. • Long-term management arrangements could be determined in consultation with relevant government agencies, stakeholders and private landowners.
Contribution to revegetation programs	• Financial contributions could be considered in consultation with relevant government agencies and stakeholders including landcare groups and Rural Lands Protection Boards.

Option	Discussion
Contribute to research	• Financial contributions could be considered in consultation with relevant government agencies and stakeholders, which could support any ongoing or proposed research programs for the management of threatened species, populations or communities.
Provide compensatory habitat through revegetation and rehabilitation of any surplus land or through additional property acquisition	• Subject to onsite investigation of the property in accordance with relevant DECC guidelines, revegetation and rehabilitation could be developed that incorporates plant species of local provenance, in particular key local species for which there are residual impacts from the proposal. • A plan of management developed in consultation with relevant government agencies and stakeholders could include long-term management arrangements and on-going rehabilitation and/or protection measures for the property where required (eg exclusion fencing). • Should additional compensatory habitat be required, investigations into acquiring land for compensatory habitat and any subsequent long-term management arrangements could be undertaken in accordance with the relevant DECC guidelines.

Following the outcomes of the fieldwork described in Chapter 18, the ongoing refinement of the ROW alignment, and if required, a detailed biodiversity offset strategy would be prepared by QHGP, which would include as a minimum:

- The identification of the extent and types of habitat that would be lost or degraded as a result of the final detailed design of the ROW alignment.
- The objectives and biodiversity outcomes that would be achieved through the final biodiversity offset package.
- Details of the available offset measures that would be implemented to provide compensatory habitat within the region of the specific impacts.
- The decision-making framework that would be used to select the final offset measures to achieve objectives and outcomes established within the strategy, including the ranking of measures.
- Mechanisms for the determination of the strategy from the Director-General of DoP prior to the commencement of any construction activities that result in the disturbance of identified threatened species, threatened species habitat or EECs or populations.

10 Heritage

10.1 Aboriginal heritage

This section provides the rationale for and the key findings from the strategic assessment of the potential impacts on Aboriginal heritage associated with the construction and operation of QHGP as well as measures that have been recommended to avoid or minimise the assessed impacts. The strategic assessment was conducted by Archaeological & Heritage Management Solutions (AHMS) Pty Ltd. A full copy of the study is provided in Appendix E. Please note that exhibits 1 to 5 to this report are confidential to Aboriginal stakeholders.

10.1.1 Aboriginal consultation

As described in Section 6.3.7 of this EA, a comprehensive process of consultation with Aboriginal stakeholders is being undertaken in accordance with the DECC, *Interim Consultation Requirements for Applicants* (2004). This process has three aims:

- Firstly, to identify and notify Aboriginal stakeholders in accordance with procedures set out in the DECC, *Interim Consultation Requirements for Applicants* (2004).
- Secondly, to obtain input on the proposed assessment methodology and the Aboriginal archaeological heritage assessment report and recommended management measures. Following the notification procedures, Aboriginal groups and individuals registered their interest in the project. Meetings were held with the registered Aboriginal stakeholders to present the proposed assessment methodology and 21 days was allowed for responses. These responses are broadly supportive and are detailed in Appendix C. The draft assessment report and management recommendations were sent to the registered Aboriginal stakeholders for their review for the required 21 day period. The feedback is documented in Appendix E.
- Thirdly, community consultation processes were utilised to identify cultural places and values known by the local Aboriginal communities, that may be affected by the QHGP. This is being supplemented by an oral history study with key Aboriginal knowledge holders. This work is currently underway and is being undertaken in collaboration with Evelyn Crawford, a DECC researcher who has extensive knowledge and experience in the area and is a respected Aboriginal elder. The oral history is being undertaken to actively identify and consult with knowledge holders and ensure that all culturally significant sites and places on or near the Study Area are identified on or near the pipeline corridor. This additional oral history research is currently being undertaken and will be completed prior to the submissions report.

10.1.2 Assessment methodology

The methodology adopted for the assessment was necessarily strategic in its approach, and designed to provide a solid basis for understanding potential impacts of the proposal on known Aboriginal heritage sites, objects and places, while at the same time developing important Aboriginal heritage constraint information to feed into the ongoing refinement of the proposal. The strategic approach also allowed a consideration of the broader issues of cumulative impact on Aboriginal heritage values, both scientific and cultural.

The objective of the assessment was to obtain information about known Aboriginal sites and heritage issues and to develop predictive models that identify areas of archaeological sensitivity for Aboriginal site types that require further investigation and/or management. The assessment was based on information derived from archaeological and environmental literature, several register searches (in particular the Aboriginal Heritage Information Management System (AHIMS database)) ethnohistorical research and Aboriginal community consultation. A synthesis of this information was used to develop predictive models for each of the five bioregions that the Study Area crosses. Each model provides predictions about the location and environmental context of areas of archaeological potential individualised for each site type.

The predictive models are robust and deliberately conservative. The modelling approach and methodology reflects best practice for large strategic assessments and mirrors current modelling practice on similar scale projects recently undertaken for large infrastructure developments and large land assets, such as the Department of Defence. There are numerous precedents that have utilised known generic archaeological information, regional studies and syntheses in a similar fashion to the QHGP assessment modelling process.

Specifically, the QHGP assessment uses focused reviews to develop predictive models for each bioregion. Bioregions are shown in Chapter 4. Bioregions have been used because they share common environmental and topographic characteristics. Given the importance of environmental factors in influencing past Aboriginal use and occupation of the land, the shared environmental features of a bioregion provide a sound basis for managing assessment of the large Study Area.

The predictive models were used to identify areas of sensitivity for the various potential site types within each bioregion. The areas of sensitivity were mapped using GIS information layers, which also formed the basis for constraint and management mapping (shown in Appendix E). The assessment recommends some further investigations and management procedures for each potential site type, their area of sensitivity and for the known sites (as outlined in 10.1.5).

A considerable degree of caution was exercised in identifying areas of sensitivity in a GIS environment. Where the data sources used did not have the level of detail required to map the sensitive area, the assessment overcompensated by capturing a broader category. This is best shown by the following example:

> *The area of sensitivity for the site type 'scarred trees' in the Brigalow Belt South bioregion is categorised as*
>
> > *"Areas containing mature and old growth trees greater than 100 years old, in particular Red river gum, coolibahs, yellow box, pillga box, bimble box, apple box and Cypress Pine" (Appendix E: p219).*
>
> *This area was mapped in a GIS environment using vegetation data that lacked the ages of the trees and species name. The assessment therefore conservatively selected all vegetation categories that included "trees" as the area of sensitivity. The specific management protocols for this site type are:*
>
> - *Survey with differential GPS, and record site location of relevant trees within areas identified as having potential in the predictive model for the Study Area;*
> - *Ensure tree location is marked on all construction plans and clearly demarcated to ensure the tree is not affected;*
> - *Avoid within the ROW.*

This conservative approach to modelling ensured that the maximum extent of areas of potential sensitivity were identified and will ensure that any subsequent investigation or research will only have the effect of narrowing or reducing the areas of sensitivity rather than expanding them.

Please refer to Section 10.1.5 and Table 10.4 for the specific management protocols and explanations for each individual potential site type within the Study Area.

Significant assessment criteria

For the purposes of the assessment, significance assessment can generally be described under three broad headings (Pearson and Sullivan 1995:7):

- Value to groups such as Aboriginal communities.
- Value to scientists and other information gatherers.
- Value to the general public in the context of regional, state and national heritage.

Identified Aboriginal heritage sites/items were assessed using the professional guidelines for the assessment of significance, and the National Parks and Wildlife Service (NPWS) Guidelines for archaeological survey reporting (NPWS, 1997). These guidelines discuss two types of significance relevant to the assessment of Aboriginal sites: cultural/social significance and scientific/archaeological significance.

Cultural/social significance may include social, spiritual, historic and archaeological values and may be relevant to sites, objects and landscapes. Assessment involves consideration of the value of a feature or site to the local Aboriginal community.

Scientific significance is assessed using criteria to evaluate the contents of a site, state of preservation, integrity of deposits, representativeness of the site type, rarity/uniqueness and potential to answer research questions on past human behaviour (NPWS, 1997).

DECC guidelines recommended criteria for assessing archaeological significance include:

- Archaeological research potential - the potential of a site or landscape to explain past human behaviour and may incorporate intactness, stratigraphic integrity, state of preservation, association of the site to other sites in the region (connectivity) or a datable chronology.
- Representativeness – all sites are representative of those in their class, however this criteria relates to preserving a representative example of the archaeological record. This criteria is considered in context of site variability in the region, resources already conserved and the connectivity of sites across the landscape.
- Rarity – how distinctive a site may be, based on an understanding of what is unique in the archaeological record. It may be assessed at local, regional, state and national levels.

The levels of significance assigned are high, moderate and low. Section 10.1.4 further describes the impact criteria used for the purposes of the assessment.

10.1.3 Existing environment

Archaeological assessments consider information about environmental context, for the primary reason that environmental characteristics play an important role in influencing the types of archaeological sites in any given area. Physical environments influence both the type and availability of natural resources and the types of cultural activities that were carried out in the past. Accordingly, these aspects also influence the types of archaeological sites that may be present.

Known Aboriginal heritage sites and items

The DECC AHIMS was searched for an area the 200m Study Area and 1.5km either side of the Study Area, providing data for an area 3.2km wide. This enabled identification of known items both within the Study Area and in the immediate vicinity of the Study Area. These sites have been considered as part of the assessment, to take into consideration any potential inaccuracies with the recording of site information, and also to provide further context to the assessment, and the pipeline route alignment. Within the 3.2km wide AHIMS search area, there are 195 registered sites (refer to Table 10.1)

Table 10.1 Registered sites within 3.2 km wide search area.

Site types	Number of sites per bioregion				
	Sydney Basin	NSW North Coast	Nandewar	Brigalow Belt South	Darling Riverine Plains
Aboriginal dreaming and ceremony	–	–	There are no registered AHIMS sites within the search area in the Nandewar Bioregion.	–	1
Artefact	106	34		13	–
Burial	–	–		–	1
Conflict	–	1		–	–
Grinding groove	1	1		1	–
Hearth, non-human bone and organic material, shell, potential archaeological deposit (pad)	1	–		–	–
Modified tree (carved or scarred)	4	–		12	14
Potential archaeological deposit	4	–		–	–
Stone quarry and artefact	1	–		–	–
Total	**117**	**36**	**0**	**26**	**16**

Source: AHIMS, AHMS Pty Ltd

Table 10.2 identifies 16 of those sites that are, or may be directly within, the Study Area and includes their assessed level of significance (using the criteria outlined above).

Table 10.2 Registered sites within 200m the Study Area

DECC site number	Site type	Site name	Significance	Bioregion	Closest KP
01-6-0007	Mission/Aboriginal ceremony and dreaming	Euraba Mission	High	Darling Riverine Plains	252
01-6-0007	Burial	Euraba Mission	High	Darling Riverine Plains	252
01-6-0009	Modified tree (carved or scarred)	Euraba Whalan Creek	High	Darling Riverine Plains	252
38-4-0927	Artefact	Site 1, Thornton North, Lot 1	Low	Sydney Basin	289
10-3-0010	Modified tree (carved or scarred)	Watervale Yards, Moree	Low	Darling Riverine Plains	305
20-4-0009	Artefact/axe grinding grooves	Wilga	Moderate	Brigalow Belt South	565
37-6-1500	Artefact (isolated find)	Site 12, Lot 12, Stanhope	Low	Sydney Basin	691
37-2-0886	Artefact	BM4	Low	Sydney Basin	697

DECC site number	Site type	Site name	Significance	Bioregion	Closest KP
37-2-0892	Artefact	BM10	Low	Sydney Basin	700
37-2-0891	Artefact	BM9	Low	Sydney Basin	701
37-2-0893	Artefact (isolated find)	BM11	Low	NSW North Coast	724
37-2-1503	Artefact (isolated find)	Abt11	Low	NSW North Coast	755
38-4-0337[1]	Conflict	Wallalong Brush (general locality)	High	Sydney Basin	770
37-6-0121	Artefact	Farley G	moderate to low	Sydney Basin	9 (lateral)
38-4-0713	Artefact	Heritage Green 23/G	Low	Sydney Basin	10 (lateral)
38-4-0730	Artefact (isolated find)	Heritage Green 22/A	Low	Sydney Basin	10 (lateral)

Source: AHIMS, AHMS Pty Ltd

Generalised summary of predictive modelling

Known sites have been presented in Section 10.1.3, however there is a potential for additional sites to be present within the Study Area. As discussed above, predictive models have been prepared for each of the bioregions to determine the potential location and environmental context of likely additional site types and the likely areas of sensitivity. A generalised summary of the predictive models prepared for the proposal, with footnotes describing key differences in the model between the different bioregions, is presented in Table 10.3.

Table 10.3 Predictive modelling – generalised summary

Site type	Environmental context	Areas of sensitivity
1. Stone artefact scatter and deposit	All areas containing topsoil	Undisturbed soils within 150m of permanent water (swamps, rivers, creeks etc) and/or stone sources.[2]
2. Rock shelter (including art, deposit, midden and burials)	Sandstone outcrop	On sandstone benches and overhang within 150m of permanent water.
3. Midden	Near coast, estuary and less commonly, freshwater streams	Within 1km of coast and estuary, or within close proximity to other water bodies.[3]
4. Axe grinding groove	Sandstone outcrop	Flat bedded sandstone near creek lines or rock pools.
5. Seed grinding dishes	Gilgai	Cracking clays with shrink swell properties.[4]

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[1] *Specific locality of conflict unknown – general locality of 'Wallalong Brush' known. Conflict may have occurred within or near proposed pipeline Study Area.*

[2] *For the Brigalow Belt South, Darling Riverine Plains and Nandewar Bioregions, these site types may also occur within palaeochannel soils, stable sand bodies or similar.*

[3] *For the Brigalow Belt South, Darling Riverine Plains and Nandewar Bioregions, these site types occur within close proximity (150m) of large water bodies such as lagoons and swamps.*

[4] *Seed grinding dish site types are not applicable for the Sydney Bioregion and the NSW North Coast Bioregion.*

Site type	Environmental context	Areas of sensitivity
6. Rock engraving	Sandstone outcrop	Flat bedded sandstone.
7. Modified trees (scarred or carved)	Areas containing remnant vegetation	Areas containing mature/old growth trees greater than 100 years in age.[5]
8. Quarry and/or stone tool source	Outcropping bedrock or gravel bed Ochre and stone[6]	Outcropping isotropic rock (particularly acid volcanics and pyroclastic, tuff, indurated mudstone, quartz, silcrete, basalt and quartzite), gravel beds on large rivers (within 150m on major rivers) and old river terraces.
9. Waterhole/well	Sandstone outcrop	Rock pools in sandstone or other rocky outcrop
10. Burials	All areas containing soft soils or sediments	Areas with deep soft or sandy soils that are not highly acidic. Alluvial and aeolian soil landscapes are particularly sensitive.[7]

Source: AHIMS, AHMS Pty Ltd

A number of other sensitive Aboriginal site types cannot be accurately modelled in a predictive fashion. These include:

- Bora or ceremonial grounds.
- Natural or mythological places.
- Missions, cemeteries, or other historic sites.
- Conflict sites.
- Other rare site types, including earth mound, resource site, or stone arrangements.

The method of identifying these site types is through register searches[8], ethno-historical research and Aboriginal community consultation. These methods were adopted to identify the site types described above within and in the vicinity[9] of the Study Area. Furthermore, an oral history study is being undertaken by a DECC researcher, Evelyn Crawford. Evelyn has extensive knowledge and experience in undertaking community consultation and oral history in north western NSW and is a highly regarded Aboriginal elder. The oral history is being undertaken to actively identify and consult with knowledge holders and ensure that all culturally significant sites and places are identified on or near the Study Area. This additional oral history research is currently being undertaken and will be completed prior to the submissions report. After this work is completed, all possible sources of information regarding sites of cultural and historical significance to the Aboriginal community will have been exhausted.

[5] *For the Nandewar, the Darling Riverine Plains and the Brigalow Belt South Bioregions, particular tree species include the Red River Gum, coolabahs, Yellow Box, Apple Box and Cypress Pine. For the Darling Riverine Plains Bioregion, subject trees include those greater than 80 years in age.*

[6] *For the Darling Riverine Plains Bioregion only*

[7] *For the Brigalow Belt South, Darling Riverine Plains and Nandewar Bioregions, areas of sensitivity for this site type also include rock shelter sites, large trees greater than 100 years old, and sandy or black earth soils.*

[8] *DECC AHIMS inventory system, the Aboriginal & Torres Strait Islander Heritage Protection Act (1982) register, National and World Heritage registers and the Register of the National Estate were searched.*

[9] *1.5km either side of the Study Area was also assessed for these sensitive and important site types.*

10.1.4 Potential impacts

Construction

Classification of potential impacts

Pipeline construction has the potential to directly impact Aboriginal cultural heritage through damage or disturbance of culturally sensitive material or places. An impact assessment has been conducted to classify the potential impacts to Aboriginal heritage sites. The classification is a combination of a significance assessment (using the criteria described above) and the level of impact to a site or a site's defined area of sensitivity (summarised in Table 10.3). Potential impacts may be direct or indirect, defined as:

- **Direct Impact** - The actual development foot print of the pipeline construction which will impact a site or area of sensitivity within the pipeline corridor.
- **Indirect Impact** - refers to impacts on visual curtilage and context of Aboriginal sites.

Potential impacts on Aboriginal heritage are classified as:

- **High Impact** – Direct or indirect development impact on a site, object or place that has a high level of scientific and/or cultural heritage significance. Any disturbance of high impact sites would represent a significant scientific or cultural loss at a local, state or national level.
- **Moderate Impact** – Direct development impact on a site, object or place that has some (moderate) scientific and/or cultural heritage significance. Disturbance of a moderate impact site would represent only a limited scientific or cultural loss at a local level.
- **Low Impact** – Indirect impact on a site that has some rarity, representativeness, archaeological research value or cultural value to the local Aboriginal community. Direct impact on a highly disturbed site or isolated find assessed to have negligible (low) scientific or cultural significance.

Potential impacts on known sites

The majority of adverse impacts to Aboriginal heritage would be avoided through careful ROW alignment and the implementation of location specific management measures through areas of identified sensitivity. A number of known sites and key site types such as scarred trees, rockshelters, axe grinding grooves, rock engravings and other (see Table 10.4), will be avoided by use of a management option referred to as 'Avoid within ROW'. In practice, the known sites and areas of defined sensitivity for these site types will be surveyed prior to construction to identify, record and flag the sites to ensure the actual pipeline trenching and associated works avoid these sites. The 200m wide Study Area allows substantial room to move the 30m wide ROW impact footprint to avoid such sites.

Of the 16 DECC registered sites that are, or may be within, the 200m Study Area, four have been categorised as 'high impact' in accordance with the criteria set out in Section 10.1.4. Three of these sites are associated with the former Euraba Mission site (AHIMS# 01-6-0007 & #01-6-0009), RNE# 1/02/191/0006) and lie within the Darling Riverine Bioregion (DRB) near KP289 and KP252. The fourth site is the Wallalong Brush Conflict Site (AHIMS# 38-4-0337) and it lies within the Sydney Basin Bioregion (SBB) near KP798. The pipeline ROW would be aligned to avoid impact on all high significance sites. Further detailed research is currently underway to determine the exact location (if possible) of the Euraba Mission sites and the conflict site at Wallalong Brush. This information would be used to ensure the proposed pipeline avoids these sites and will be completed prior to the submissions report. All direct and indirect impacts to highly significant sites will be avoided as a baseline management policy.

Sensitive site types that would be considered to be high impact if subject to direct construction impacts are as follows:

- Bora/ceremonial.
- Natural/mythological.
- Mission, cemetery, historic site.
- Conflict site.

The proposal has the flexibility to avoid direct impacts on known site types listed above.

For sites categorised as ‘low to moderate impact’ (12 sites in total), the proposed development is likely to cause only limited scientific or cultural loss by disturbing or destroying archaeological deposits and surface sites in each area that the proposal passes through, but the overall cumulative impact of the pipeline development may be substantial. These will be collectively managed in a strategic way that considers the cumulative impact and includes offset mitigation, including a research excavation program as described in the following section 10.1.5.

The information contained within the predictive models, therefore provides for informed management of potential impacts (summarised in Table 10.4) as detailed design of the proposal continues, supplemented with information from ongoing community consultation and further investigations. Details of the management recommendations for the 16 identified high, moderate and low impact sites are summarised in Table 10.5 in the section below.

Operation

Operation of the pipeline is not anticipated to impact on items of Aboriginal cultural heritage, as activities on the ground will primarily be confined to surveillance work. All sites will be clearly defined within the pipeline database and staff inductions would highlight the areas that are to be avoided. Any maintenance works that require disturbance of the ground would be carried out in accordance with the recommended management measures for construction activities.

10.1.5 Proposed mitigation and management measures

The final alignment of the ROW would ensure the identified high significance sites (refer to Table 10.2) would not be directly or indirectly impacted. All highly significant sites will be avoided. Accordingly, no mitigation and management measures are required for these sites. The specific location of these sites would be re-confirmed through survey and/or oral history research currently underway and to be completed prior to the submissions report. They will be clearly marked on construction plans to ensure no disturbance.

For other sites of low to moderate impact, taking a precautionary approach, a number of mitigation and management measures have been developed for construction of the pipeline with the aim of minimising or mitigating the potential for adverse impacts on Aboriginal heritage.

This sub-section summarises the generalised proposed management approaches and the recommended management approaches for each site type. These approaches are reflected in the draft statement of commitments (refer Chapter 19, Table 19.1)

High Impact Site Types

Avoidance in the ROW Required

Site types that are likely to have a high level of cultural significance and sensitivity to the Aboriginal community will be considered as high impact sites and will need to be avoided by the QHGP. This assessment has endeavoured to identify as many of these sites as possible, drawing on historical evidence and consultation with local Aboriginal communities. If any other culturally significant sites, such as former missions, cemeteries, bora/initiation sites, natural/mythological sites etc are identified, the pipeline will need to either divert around the site or under the site using directional drill.

There will be no indirect impacts to these sites. There are no visual curtilage issues as the pipeline construction uses a cut and cover approach (ie the pipeline is below ground). Any necessary aboveground infrastructure required will be mitigated, depending on the impact classification (described below and Table 10.4). Measures have been developed for the required signage in sensitive areas in accordance with *AS2885*. Therefore all visual curtilage or contextual impacts will be negligible.

Low-Moderate Impact Site Types

The known moderate to low impact sites and areas of archaeological sensitivity would be managed with generalised investigative and mitigative approaches including a program of archaeological research monitoring, survey and avoidance within the ROW.

Program of Archaeological Research

In the past, archaeological investigations for linear developments such as pipelines, power lines and roads have involved survey of areas with low ground visibility, followed by dispersed test pitting programs in many areas defined as 'Potential Archaeological Deposits'. This approach was time consuming and had limited value from an archaeological research point of view because stone artefact samples were often too small to adequately characterise the archaeological site[10] and too small to make any meaningful conclusions about past use and occupation. Such investigations often failed to identify intra-site variation and patterning – issues that are critical in gaining a meaningful understanding of Aboriginal use and occupation of the broader landscape and particular landforms within the landscape.

For the QHGP project a more strategic and holistic approach is adopted to manage the many moderate to low impact artefact scatter / deposit sites. The reasoning behind this approach is that impact will be fairly minor in each area that the ROW passes through, but the overall cumulative impact along the whole ROW may be significant. Using this approach, a larger research-focused open-area excavation is recommended as a mitigation measure designed to investigate research questions that may provide meaningful information about how Aboriginal people lived and used the land in the past. The archaeological research recommended would be done as mitigation of generalised impact on the many low and moderate impact artefact scatter / deposit sites along the pipeline route[11]. The benefits of this management approach is that it will:

- Provide better mitigation of the cumulative impact of the QHGP.
- Identify rare artefact types, providing a much better understanding of how the landscapes and places were used. The relationship between activities at the site and local resources can be more thoroughly examined.
- Facilitate comparisons with other excavated sites, which may provide information about the types of activities that occurred on particular landforms and near particular resources.
- Provide more meaningful mitigation outcomes rather than lots of smaller investigations.

Prior to commencement of construction, a suitably qualified archaeologist would be engaged to develop an archaeological research excavation program that aims to undertake comparison of intra-site patterning, Aboriginal occupation and use of analogous landforms between each bio-region. It is suggested that controlled manual open-area excavation methods are used (minimum 100m^2) for each bioregion. It is further suggested

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[10] Hiscock 2001

[11] This approach follows that used in Biodiversity and Ecological management commonly referred to as 'offsetting' where strategically-focused management measures are adopted to mitigate against cumulative impact.

that undisturbed landforms adjacent to high order streams or at resource intersection zones are targeted for the investigations in each bioregion.

Monitoring

Monitoring of development excavation works is recommended for areas that have potential to contain Aboriginal burials (as developed and presented in the predictive model mapping included in Appendix 5 of the Aboriginal Heritage Assessment report prepared by AHMS. Please note, this Appendix is not included in the public exhibition due to reasons of cultural sensitivity). The precise location and preservation of burials within these soil types cannot be predicted with any degree of accuracy. Nor can they be detected by archaeological survey because they are usually below current ground surfaces. Archaeological test excavation may identify some burials, but may not detect burials if they fall within un-excavated areas between test trenches. Therefore, the only effective method for identifying burials is to undertake monitoring of the development excavation works by representatives of the local Aboriginal community and a suitably qualified archaeologist / physical anthropologist on call. In order for this management approach to be successful, contingency plans should be prepared in the event that skeletal remains are revealed during the excavation. As part of this contingency plan, legal requirements to notify the NSW State Police and/or State Coroner would be included. Development of contingency plans will require further consultation with Aboriginal stakeholders to identify what each community considers to be appropriate management. Appropriate management is likely to vary in different areas of the ROW to suit the particular requirements of each Aboriginal community. A range of contingency options may be required, including:

- Stop work in the immediate vicinity, record remove and re-bury off site.
- Stop work in the immediate vicinity, record, cover and divert pipeline away from the burial.
- Stop work in the immediate vicinity, record, cover and directional drill underneath the burial (this option is likely to be preferred where it is suspected that more burials may be present.

Construction plans will need to be clearly marked with the areas requiring monitoring and protocols established to contact the project's consultant well in advance of work in these areas to ensure monitors are present on required days.

Avoid within ROW and Survey

The width of the 200m Study Area relative to the ROW 30m width of likely impact provides an opportunity to avoid many site types that are likely to be limited to specific locations. Such site types include scarred/carved trees, rockshelters, axe grinding grooves, engravings, earth mound, quarry, well, stone arrangement and other. These site types are usually limited in size and extent, therefore there is a high likelihood they can be avoided within the 200m Study Area by moving the 30m wide ROW impact zone away from the individual site.

This management approach will require archaeological survey of relevant areas of sensitivity as defined in the predictive model mapping for the applicable site types. The archaeological survey would be conducted by a suitably qualified archaeologist with assistance from representatives of the local Aboriginal community. The survey would aim to identify and accurately record applicable sites so that they can be avoided during development, and where appropriate fenced off or clearly demarcated as a sensitive area to be avoided. The site locations will need to be marked on relevant construction plans to ensure the site is not impacted by development works. Monitoring of such identified sites during the development works (by a suitably qualified archaeologist and Aboriginal community representatives) would also be required to ensure the site is identified in the field, construction crews are made aware of its location and the no ancillary or accidental damage is caused to the site.

Prior to commencement of development works, a suitably qualified archaeologist or archaeological consultancy should be engaged to undertake survey of the applicable areas of sensitivity shown on the constraints plans included in Appendix E. The applicable site types where survey is required are rockshelters, middens, axe grinding grooves, seed grinding dishes, rock engravings, scarred and carved trees, and quarries and/or stone tool sources. These are also described in Table 10.4.

Table 10.4 Aboriginal heritage general mitigation and management measures

Potential Impacts	Mitigation and management measures
General Measures: low to moderate impact predicted sites if encountered	

Low to moderate impact sites (in general)	• All personnel and contractors working on site would receive training in their responsibilities under the *National Parks and Wildlife Act 1974* as part of an Aboriginal heritage induction program prior to the start of construction works.
	• A mechanism would be developed to provide for the management of impacts on artefact scatters above a given density. This mechanism would:
	  • State thresholds when works would stop in the immediate vicinity.
	  • Identify relevant project personnel with authority to stop works in the immediate vicinity when the prescribed threshold is reached.
	  • Include provision for verification of significance of the find by the project archaeologist or similar.
	  • Provide a framework for the resolution and management of the find, seeking input from relevant Aboriginal groups, and the DECC.
	• As part of an offset program for cumulative impacts to these sites, and in collaboration with a suitably qualified archaeologist, develop an archaeological research excavation program with the aim of completing a comparison of intra-site patterning, Aboriginal occupation and use of analogous landforms between each bioregion.

Specific Measures: low to moderate impact of predicted sites by site type, if encountered	
Consult the relevant predictive model and constraint mapping to identify likely areas where site types are present and implement the following management measures:	
Disturbance or destruction of previously unidentified stone artefact scatter and deposit	• Management of cumulative impacts by undertaking a program of archaeological research based on targeted open-area excavation(s) designed to address comparative inter-bioregional research questions (described above).
Disturbance or destruction of previously unidentified rock shelters	• Survey of large rock outcrop and escarpment features within the construction footprint, in accordance with the relevant predictive model and constraint mapping. • Avoid within the ROW.
Disturbance or destruction of previously unidentified middens	• Avoid within the ROW if possible. • Mitigate impact by undertaking a program of archaeological research (details below). • Survey within the ROW that is within 1km of a coast or estuary.
Disturbance or destruction of previously unidentified axe grinding grooves	• Survey of sandstone outcrop within the construction footprint, in accordance with the relevant predictive model and constraint mapping. • Avoid within the ROW.

Potential Impacts	Mitigation and management measures
Disturbance or destruction of previously unidentified seed grinding dishes	• Survey areas of Gilgai prone soil environments within the construction footprint, in accordance with the relevant predictive model and constraint mapping. • Avoid within the ROW.
Disturbance or destruction of previously unidentified rock engravings	• Survey areas of sandstone outcrop within the construction footprint, in accordance with the relevant predictive model and constraint mapping. • Avoid within the ROW.
Disturbance or destruction of previously unidentified modified trees (scarred and carved)	• Survey with differential GPS, and record site location of relevant trees within areas identified as having potential in the predictive model for the 200m Study Area. • Ensure tree location is marked on all construction plans and clearly demarcated to ensure the tree is not affected. • Avoid within the ROW.
Disturbance or destruction of previously unidentified quarry and/or stone tool source, l	• Undertake archaeological survey to determine significance of the site. • Avoid within the ROW.
Disturbance or destruction of previously unidentified waterhole/well	• Avoid within ROW
General Measures: high significance sites that may be encountered	
High significance and impact sites (in general) Disturbance or destruction of previously unidentified Aboriginal heritage associated with former missions, cemeteries, or other historic sites with a high level of cultural significance.	• Avoid any impacts to culturally significant sites and/or places is required. • Continue Aboriginal community consultation with a focus on oral history to identify any previously undocumented sites or places within or adjacent to the proposal. • Specific training will be given to workers when working within identified sensitive zones as per the predictive model
Specific measures: high significance sites by site type, if encountered	
Disturbance or destruction of previously unidentified burials	• Monitoring of development excavation works in sensitive areas in accordance with the relevant predictive model and constraint mapping. • Should any heritage items be uncovered during works, all works in the vicinity of the item would cease immediately and the Site Foreman contacted. Specialist advice would be sought as necessary and work would not recommence until appropriate clearance received. • Development of specific contingency management measures, which would include legal requirements to notify NSW State Police and/or State Coroner. in consultation with relevant Aboriginal community members, archaeologists and DECC.
Bora/Ceremonial sites	• Avoidance of any impacts is required.
Natural/Mythological sites	• Avoidance of any impacts is required.
Mission/Cemetery/ Historic site	• Avoidance of any impacts is required for sites that are culturally significant. • Undertake detailed survey with Aboriginal elders to identify the extent of the mission site, including all areas and features of cultural importance.

Potential Impacts	Mitigation and management measures
Conflict site	• Avoidance of any impacts is required.
Other rare site types: earth mound/ resource site/stone arrangements.	• Avoidance of any impacts is required.
Accidental impact to known sites	
Potential for accidental impact to the identified Aboriginal heritage items	• The locations of known Aboriginal heritage items would be identified on alignment sheets to avoid accidental impact.
Operational	
Impact on Aboriginal heritage items following project delivery	• The identified Aboriginal heritage items would be recorded in the QHGP maintenance GIS to ensure that future maintenance works do not impact upon them. • Staff inductions would include information about the known presence of Aboriginal heritage items associated with the Project and the relevant management measures in place.

Table 10.5 outlines the application of the principles in the Table 10.4 management measures to the 16 known sites that would be subject to impact.

Table 10.5 Aboriginal management and mitigation measures for 16 known sites

Known sites name and site ID number	Mitigation and management measures
High Impact Sites	
Euraba Mission 01-6-0007 (Mission and Burial) and 01-6-0009 (Scarred Tree), RNE# 1/02/191/0006	• Undertake historical archaeological survey with Aboriginal elders to identify the extent of the mission site, including all areas and features of cultural importance; • Avoid any impact on the identified mission area; and • Align pipeline ROW to ensure it does not cross the area of identified mission.
Wallalong Brush 38-4-0037	• Undertake primary historical research and oral history research with any Aboriginal knowledge holders to identify the nature of the conflict, specific locality of conflict and to assess the cultural importance of the place to the local Aboriginal Community; • Further management will depend on the results of the research, and in particular the cultural significance of the place and views of Aboriginal stakeholders; and • At a minimum, monitoring of development works in this area will be required.
Moderate-Low Impact Sites	
Wilga 20-4-0009	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites. • Avoid the axe grinding groove within the 200m corridor. Survey to identify and accurately record site location required.

Known sites name and site ID number	Mitigation and management measures
BM 4 37-2-0886	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
BM 9 37-2-0891	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
BM 10 37-2-0892	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
BM 11 37-2-0893	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
Abt 11 37-2-1503	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
Farley G 37-6-0121	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
Site 12 Stanhope 37-6-1500	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
Heritage Green 23/G 38-4-0713	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
Heritage Green 22/A 38-4-0730	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
Site 1 Thornton North 38-4-0927	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.
Watervale Yards, Moree 10-3-0010	• Impact mitigated as part of archaeological research program for cumulative impact offset on all the moderate to low impacts sites.

10.2 Historical heritage

A preliminary historical heritage assessment has been undertaken by AHMS (refer to Appendix F). Historical heritage was not identified as a key assessment requirement within the DGRs. However, the environmental risk analysis undertaken for the proposal (refer to Chapter 8) identified historical heritage as a key issue. This primarily resulted from consultation with relevant stakeholders. The approach to historical heritage presented here is conservative and precautionary, as the majority of heritage items within and near the Study Area would be avoided by the QHGP.

The route development process (refer to Chapter 3) and overall design methodology for the QHGP inherently incorporates mechanisms that minimise interactions with, and potential impacts upon, heritage items. For example, many historical heritage items are located within towns or settlements, which are specifically avoided by the Study Area. The route selection process is undertaken in consultation with landowners and other stakeholders, as well as with consideration of the preliminary historical heritage assessment, all of which can assist in locating the ROW away from known or potential heritage items.

10.2.1 Assessment methodology

The historical heritage assessment methodology focuses on two key streams. The first identifies known heritage values within the vicinity of the Study Area and the second investigates potential heritage values that have not been previously recorded. To assist with this process, a thematic study characterises all heritage items within and adjacent to the Study Area (eg agriculture, environment, mining, transport etc).

In general, the assessment process consists of:

- Identifying known historical heritage sites within the 200m wide Study Area and up to 3km from the Study Area.
- Identifying potential heritage sites or places within the Study Area and up to 1km of the Study Area, using a predictive model and the thematic study.
- Assigning a level of significance to known and potential heritage items, which is used to classify the level of impact.
- Identifying those heritage items that represent a potential constraint to the proposal.

Known heritage items

Known heritage items (including ‘places, buildings, works, relics, moveable objects or precincts’ as defined by the *Heritage Act 1977*) were identified through a comprehensive desktop review of statutory and non-statutory listings of heritage items located within a maximum of 3km from the Study Area. This review included:

- Consultation with local Councils and local historical societies.
- Inspection of heritage registers, schedules or lists within environmental planning instruments, such as:
  - The Register of the National Trust.
  - The Australian Heritage Database.
  - The State Heritage Register (SHR).
  - LEPs and REPs.
- Review of the Draft Upper Hunter Regional Heritage Study (refer to Appendix F).
- Review of the Moree Plains Draft Heritage Study (refer to Appendix F).

The desktop survey also included searches of the S170 Registers compiled by the ARTC, RailCorp, the RTA and the DPI. The ARTC information also provided details of items not listed on the S170 register, but which are considered to be of potential heritage significance. Other sources of known heritage items utilised included the Register of The National Estate, Commonwealth Heritage List and the Register of the National Trust (NSW), as well as Local and Family Historical Societies.

Each item identified through this process was given a unique number and then mapped using GIS. The proximity of these items to the pipeline was recorded and where necessary, information was sought to confirm available property/item details from the relevant sources to assist this process.

Predictive model – potential heritage items

Identification of potential features and elements included identifying their association with, or the potential to demonstrate or embody, an historic theme as identified in the thematic history. Potential heritage items were identified by analysing a series of historic aerial photographs of the Study Area ranging in date from late 1950s to mid 1960s. These were inspected for indications of features and elements that would suggest the presence (at that time) of an extant structural or landscape element, or substantial structural remains. A premise of the predictive model was that the elements identified in the 1950s or 1960s aerial photographs had the potential to be of some heritage value, or to be a 'relic' as defined by the *Heritage Act 1977*. Each item identified through this process was given a unique number and then mapped using GIS (refer to Appendix F).

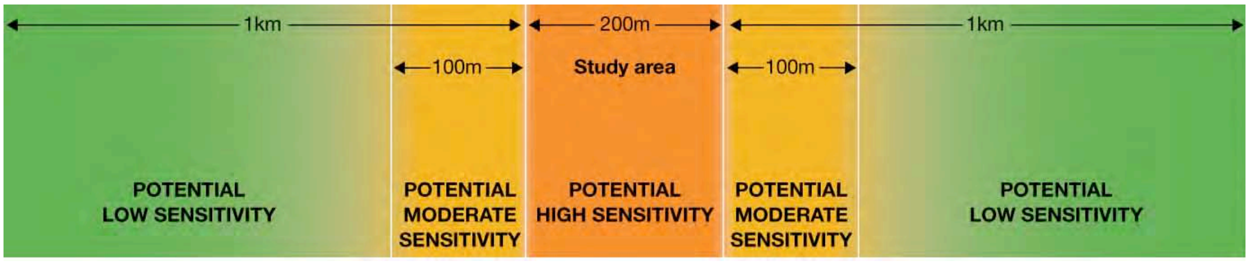
Assessment of significance and sensitivity

Comprehensive assessments of significance have been previously undertaken for certain heritage items and places (refer to Appendix F). Where available, this assessment utilised these previous studies to determine the heritage significance of an item or place. For the purposes of this assessment, all known items and places on the SHR are considered to be of high heritage significance. Known items identified only on other statutory lists, such as LEPs, were generally graded as either of medium or high heritage significance, depending on their perceived ability to express or embody the relevant historic themes that apply to their local area. Known items graded as low heritage significance are predominantly those about which little is known or are as yet only nominally identified on lists (eg 'culvert'). Sensitive sites like cemeteries and grave sites were all graded as high heritage significance.

A thematic approach applied to potential heritage items and places that could be impacted by the proposal for the significance assessment. Groups of places and sites likely to contain surviving elements relevant to the heritage themes, or which would embody or illustrate those themes, were identified as items likely to have potential heritage significance.

The methodology for classification of potential sensitivity related to the proximity of known and potential heritage items to the Study Area (refer to Figure 10.1). All known and potential heritage items located within the 200m wide Study Area were considered to be of high sensitivity in relation to potential impacts due to their proximity to the pipeline construction activities. Moderate and low sensitivity was defined as those items located within 100m, and up to 1km of the Study Area respectively.

Figure 10.1 Potential impact classification



Constraints identification

Constraints were identified by cross-referencing, in a matrix, the potential sensitivity against known or potential significance value. The matrix adopts the approach that the higher the significance value and sensitivity, the more that heritage item may be a constraint on the proposal (refer to Figure 10.2). This process informs field investigation and detailed design, with the aim to:

- Avoid all hard constraints.
- Avoid moderate and low constraints (where practical).
- Mitigate any impacts upon these heritage items.

Figure 10.2 Heritage constraint assessment matrix

	LOW SIGNIFICANCE	MEDIUM SIGNIFICANCE	HIGH SIGNIFICANCE
POTENTIAL HIGH SENSITIVITY	Moderate constraint	Hard constraint	Hard constraint
POTENTIAL MODERATE SENSITIVITY	Low constraint	Moderate constraint	Moderate constraint
POTENTIAL LOW SENSITIVITY	Low constraint	Low constraint	Low constraint

10.2.2 Existing environment

Known heritage items and places

There are 20 known heritage items and places within the 200m wide Study Area and 269 located within 3km of the Study Area (refer to Table 10.6 and Appendix F). These differ in nature along the proposed route, reflecting the local historical characteristics of each region. The heritage items often relate to the agricultural history of the regions, but also reflect the development of the region, such as buildings, roads and railway features, or the people of the region, with such items as graves or memorials.

Table 10.6 Known heritage items and places proximate to the Study Area

Local government area	Items within the Study Area	Items within 1km	Items between 1 and 3km*
Moree Plains	6	9	11
Narrabri	0	1	11
Gunnedah	4	3	3
Liverpool Plains	2	1	3
Upper Hunter	4	60	60
Muswellbrook	3	0	1
Singleton	1	1	4
Maitland	0	37	9
Port Stephens	0	3	27
Newcastle	0	3	22
Total	**20**	**118**	**151**

**These items were used to inform the understanding of the heritage landscape of each region but were excluded from the constraints assessment due to distance from the Study Area. Note that some of the above items have been duplicated in more than one LGA refer Appendix F.*

Potential heritage items and places

There are 51 potential heritage items and places identified within the 200m wide Study Area and 162 within 1km of the Study Area (refer to Table 10.7 and Appendix F). These relate to the wide variety of heritage themes that are identified within the regions. Specific items and places have been identified that reflect the exploration, land use, cultures, transport and people of the regions.

Due to the desktop nature of this study and the level of information available at this time, there is some overlap between the known and potential sites. Within the Study Area and within 1km of the Study Area, the amount of double counting between the known and potential sites is estimated at 25 records. However, a precautionary approach has been taken that assumes that no double counting has occurred and the number of potential heritage items noted in Table 10.7 includes those that are likely to correlate with known items.

Table 10.7 Potential heritage items and places proximate to the Study Area

Local government area	Potential items within Study Area	Potential items within 1km
Moree Plains	6	34
Narrabri	2	33
Gunnedah	3	24
Liverpool Plains	12	22
Upper Hunter	10	27
Muswellbrook	2	3
Singleton	0	12
Maitland	12	2
Port Stephens	0	2
Newcastle	4	3
Total	**51**	**162**

Heritage constraints

Known and potential heritage items, noted in Tables 10.6 and 10.7, were characterised as being hard, moderate or low constraints, depending on their heritage significance and the potential sensitivity (proximity to the Study Area).

The constraints assessment concluded that there were 13 known heritage items that are considered to be a hard constraint and nine known items that are considered a moderate constraint (refer to Table 10.8).

Table 10.8 Known hard and moderate heritage constraints

KP	ID*	LGA	Item name	Constraint level
222	3	Moree Plains	Boonanga Bridge over Barwon River	Hard
251	269	Moree Plains	Euraba Mission	Hard
365	268	Moree Plains	Tramby Graves	Hard
634	305	Liverpool Plains	Ardglen Railway Station	Hard
635	57A-B	Liverpool Plains Upper Hunter	Ardglen Tunnel	Hard
641	293	Upper Hunter	Residence, Murrurundi	Hard
641	275	Upper Hunter	Murrurundi Urban Conservation Area	Hard
651	291	Upper Hunter	Peter Clark Memorial	Hard
673	284	Upper Hunter	Residence, Middle Brook	Hard
701	303	Muswellbrook	St Helier's Cemetery	Hard
701	302	Muswellbrook	St Helier's township – associated buildings	Hard
702	301	Muswellbrook	St Helier's township – limestone kiln	Hard
732	173	Singleton	Greylands and outbuildings	Hard

KP	ID*	LGA	Item name	Constraint level
296	316	Moree Plains	Road crossing	Moderate
312	313	Moree Plains	Road crossing	Moderate
318	307	Moree Plains	Road crossing	Moderate
570	298	Gunnedah	Culvert	Moderate
572	297	Gunnedah	Culvert	Moderate
574	295	Gunnedah	Culvert	Moderate
574	296	Gunnedah	Culvert	Moderate
694	277	Upper Hunter	Pumphouse, Aberdeen	Moderate
817	246	Newcastle	131 Radar Igloo	Moderate

**As noted in Appendix F.*

In addition to the known constraints, the preliminary historical heritage assessment (refer to Appendix F) concluded that there were 49 hard and 20 moderate potential heritage constraints. The potential hard constraints are located within the Study Area and are deemed to be of high potential heritage significance. The potential moderate constraints are located within the Study Area or very nearby and deemed to be of medium potential heritage significance.

There are 114 known and 142 potential heritage items that are considered to be a low constraint. Many known items in this category are located in towns and urban areas and are substantial built structures. It is unlikely that they would be impacted directly by construction or operation of the QHGP.

10.2.3 Potential impacts

Construction

The potential impacts on heritage items would generally relate to the undertaking of work (namely excavation, construction of new structures/plant and vegetation clearance) that result in the direct disturbance and/or modification of the fabric, setting, views and/or the public's future enjoyment of heritage items. Through this assessment, the known and potential heritage items and places in the vicinity of the Study Area have been identified and classified as being hard, moderate or low constraints. The potential impacts on heritage would vary depending on the constraint classification and the nature of the particular heritage item.

For this assessment, potential impacts have been characterised as:

- Potential impacts on hard and moderate heritage constraints, particularly impacts on built heritage, archaeological or landscape items of state or local significance.
- Potential impacts on low heritage constraints.

Operation

The potential impacts on heritage items and places during operation of the QHGP would differ depending on the type of heritage item and the significance of the item. In general, the operational impacts on heritage items would be minor, as most issues would have been addressed in the detailed design and construction phases.

During detailed design, and as the ROW alignment is further refined, heritage items that would be affected by the final alignment would be further investigated. The significance, impact and constraint classification process would be applied to any alignment modifications. Those heritage items remaining hard or moderate constraints (ie those that should be avoided) at the construction stage would be assessed in detail and the potential impacts on those items at the operation phase would be identified and addressed.

10.2.4 Proposed mitigation and management measures

Detailed design phase

During the design phase, the following mitigation and management measures are proposed:

- Use the preliminary heritage assessment to inform the alignment of the ROW to minimise any potential adverse impacts to heritage items and places.
- Review the heritage assessment with respect to the final ROW and construction methods. Further research may be required to identify the values and heritage curtilage of each heritage item that remains a hard or moderate constraint within the ROW.
- Maintain consultation with the Heritage Branch of DoP, local councils and other relevant stakeholders with regard to any further heritage investigation and proposed mitigation measures.
- Include relevant known and potential heritage constraints, mitigation and management measures within the CEMP.

Construction

The management and mitigation measures proposed during the construction phase (refer to Table 10.9) would be detailed within the CEMP.

Table 10.9 Mitigation measures proposed for potentially impacted heritage items

Potential Impact	Mitigation measures
Potential impacts on hard and moderate heritage constraints	• Field investigation to confirm location, establish significance and determine potential impact to constraints. • If hard constraint, aim to avoid in ROW. • Maintain consultation with the Heritage Branch of DoP, local councils and other relevant stakeholders. • If item or place cannot be avoided, implement management measures, such as a photographic or archaeological study of the item. • Include relevant known and potential heritage constraints within the CEMP.
Potential impacts on low heritage constraints	• No specific mitigation measures are required, however photographic recording of low heritage constraints would be undertaken, where appropriate.

Operation

Mitigation measures that would be applied at the operation stage would be developed at the detailed design and construction phases. These would relate to the heritage significance of an item or place, as well as reflect the nature of the heritage item. It is unlikely that extensive mitigation measures would be required during operation of the QHGP, as the pipeline would be buried for its entire length and most heritage issues would have been addressed during detailed design and construction phases.

11 Human amenity impacts

11.1 Introduction

Chapter 11 provides an assessment of the potential impacts to human amenity associated with the proposal, as well as a framework for the mitigation, management and monitoring of identified adverse impacts in line with relevant regulatory requirements and industry guidelines. Given the scale of the proposal, the assessment is necessarily qualitative, drawing on a variety of data sources and assessment approaches to identify and understand areas where potential impacts may occur. Where certain elements of the proposal are characterised in general terms only, a general mitigation and management approach has been developed for application and further refinement, with inputs from ongoing detailed design, stakeholder engagement, and enhanced and more reliable data inputs.

11.2 Characterisation of human receptors

11.2.1 Data analysis

A GIS analysis was undertaken, to determine human receptors along the Study Area. Given the length of the pipeline, and for practicality purposes, existing data sets were utilised using GEODATA TOPO 250K Series 3 products produced by Geoscience Australia (Geodata). Geodata is based on a 1:250 000 scale topographic map and is a digital representation of features on the earth's surface. Features include buildings, roads and lakes and are spatially represented as points, lines or polygons, and attributes. Generally, Geodata (Series 3) is less than five years old.

11.2.2 Data limitations

For the purposes of this assessment, it was not possible to determine the exact detail of each data feature identified. Further, based on limitations relating to the accuracy and currency of the data, it is likely that not all data has been captured.

Some limitations noted from the data analysis include:

- Within a populated place, it is not possible to determine the exact location of sensitive receptors such as schools or hospitals, as these features are not separately contained within the dataset.
- A building point identified within the data set may be located within a built up area. However, it is noted that, for the majority of the Study Area, building points were within isolated locations.
- A building point may not be a sensitive receptor type. For example, it is noted that Kooragang Coal Terminal has been identified as a building point in the data set, but this would not be considered as a sensitive receptor type.
- A homestead may be identified within the data set but could be abandoned. Conversely, there may be new homesteads not as yet identified by the Geodata.
- A building point may pick up a non-residential feature, such as a silo or shed.

11.2.3 Human receptor analysis

The data features identified in Table 11.1 were used to represent human receptors along the Study Area. Data sets were categorised into receptor types: isolated, sensitive or residential zones, taking into consideration the limitations noted in Section 11.2.2. Sensitive receptors were defined as those features that were likely to be less receptive or adaptive to changes in the surrounding ambient human amenity conditions. Human amenity conditions are defined as being changes relating to air, noise quality and existing traffic conditions. A residential zone was considered to be an area in which residences and services were in close proximity to each other. This is the converse for isolated residences.

The following data sets were identified as being isolated:

- Homesteads (isolated residence).
- Building points.
- Building areas.

The following data sets were identified as being sensitive:

- Recreation areas.
- Cemeteries.
- Hospitals.

The following data sets were identified as being within a residential zone:

- Populated place.
- Built up area.

Figures 11.1 to 11.17 show, on a regional basis, the characterisation of human receptors within the vicinity of the Study Area.

The data sets examined using Geodata were the 'Habitation' class feature. A summary of the data sets examined, a description of the data feature and the assumed (for the purposes of this assessment) type of receptor is given in Table 11.1.

Table 11.1 Identification of receptor types

Data feature*	Feature type definition*	Receptor type
Populated places	A named settlement with a population of 200 or more.	Residential area that may contain sensitive receptors such as schools or hospitals.
Built up area	An area where buildings are close together and have associated road and other infrastructure networks.	Residential area that may contain sensitive receptors such as schools or hospitals.
Homestead	A named prominent building or set of buildings which is/are the place of permanent residence in rural areas.	An isolated receptor.
Building point	A permanent walled and roofed construction or the ruin of such a construction.	An isolated receptor.
Building area	A permanent walled and roofed construction or the ruin of such a construction, capable of being represented at scale.	An isolated receptor.

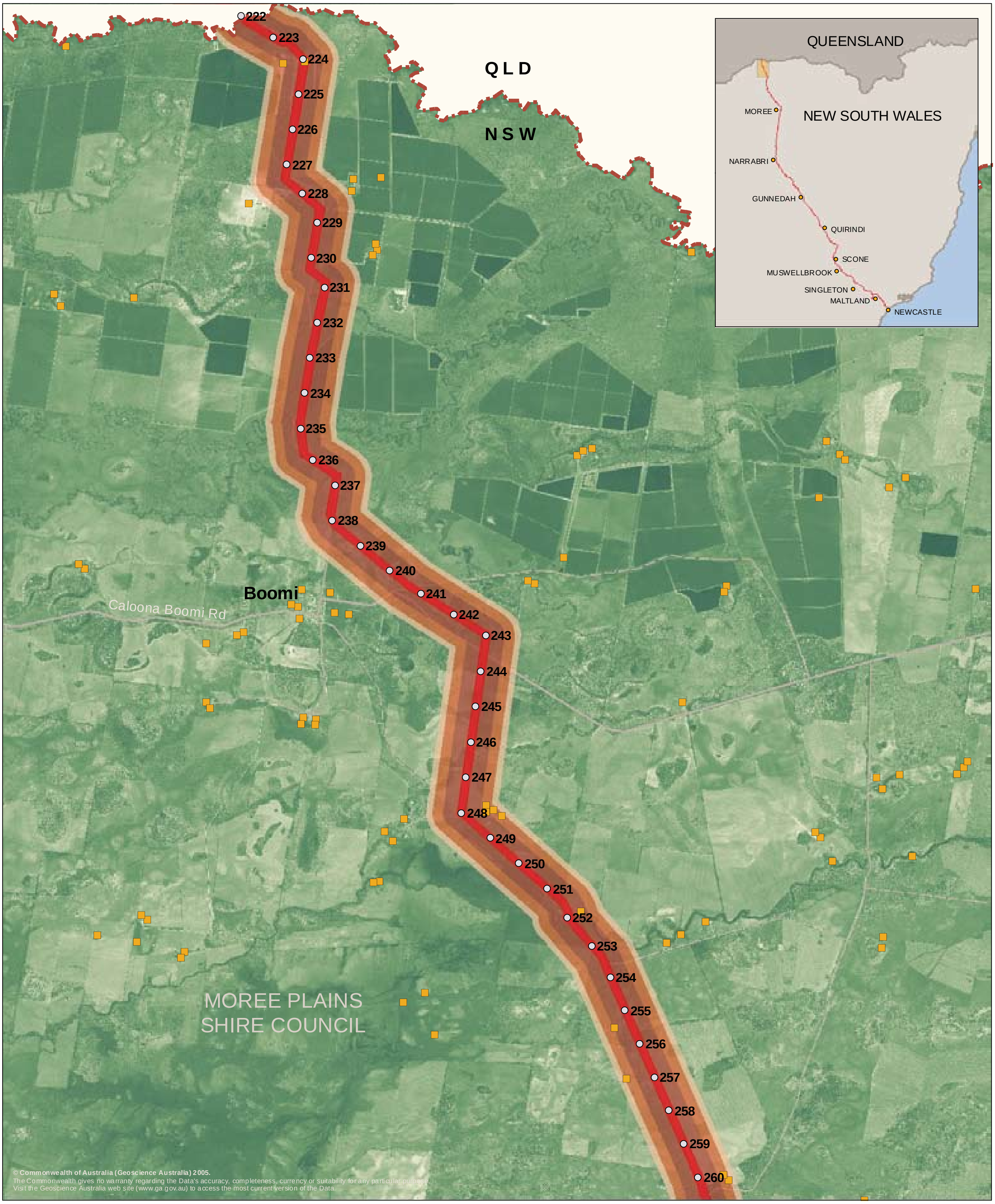
Data feature*	Feature type definition*	Receptor type
Recreational area	Comprising the following feature types: • Civic squares. • Gardens. • Golf courses. • Multiple use areas – an area of land developed for a combination of recreational purposes. • Oval area – a sporting ground. • Racecourse. • Recreational area – a large park in a residential area. • Rifle range. • Show ground.	For the most part, given the existing ambient amenity afforded by recreational areas, these have been identified as sensitive areas.
Cemetery	An area of land for burying the dead.	Sensitive areas.

**Source: Geoscience Australia, 2005*

11.2.4 Data validation

The human receptor analysis is the first stage in identifying human receptors along the Study Area. It is accepted that there will be inaccuracies based on the limitations of the data analysis, as detailed in Section 11.2.2. However, given the scale and practicalities relating to the identification of all human receptors along the Study Area, it is considered that this aspect is a 'works-in-progress' for the QHGP proposal.

A comprehensive and thorough process is being undertaken to identify all landowners and human receptors within the Study Area. This will further identify and confirm human receptors and any construction and operational specific aspects that need to be taken into consideration by the proposal development team.



Drawing no. 07002g_CP_HA_01-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- State border

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.1 Human receptors - Boomi area

Drawing no. 07002g_CP_HA_02-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.2 Human receptors - Garah area

Drawing no. 07002g_CP_HA_03-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.3 Human receptors - Ashley area

Drawing no. 07002g_CP_HA_04-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- Built up area

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.4 Human receptors - Moree area

Drawing no. 07002g_CP_HA_05-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- LGA boundary

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.5 Human receptors - Bellata area

Drawing no. 07002g_CP_HA_06-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.6 Human receptors - Narrabri north area

Drawing no. 07002g_CP_HA_07-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- Built up area

Isolated residences potential noise impact:

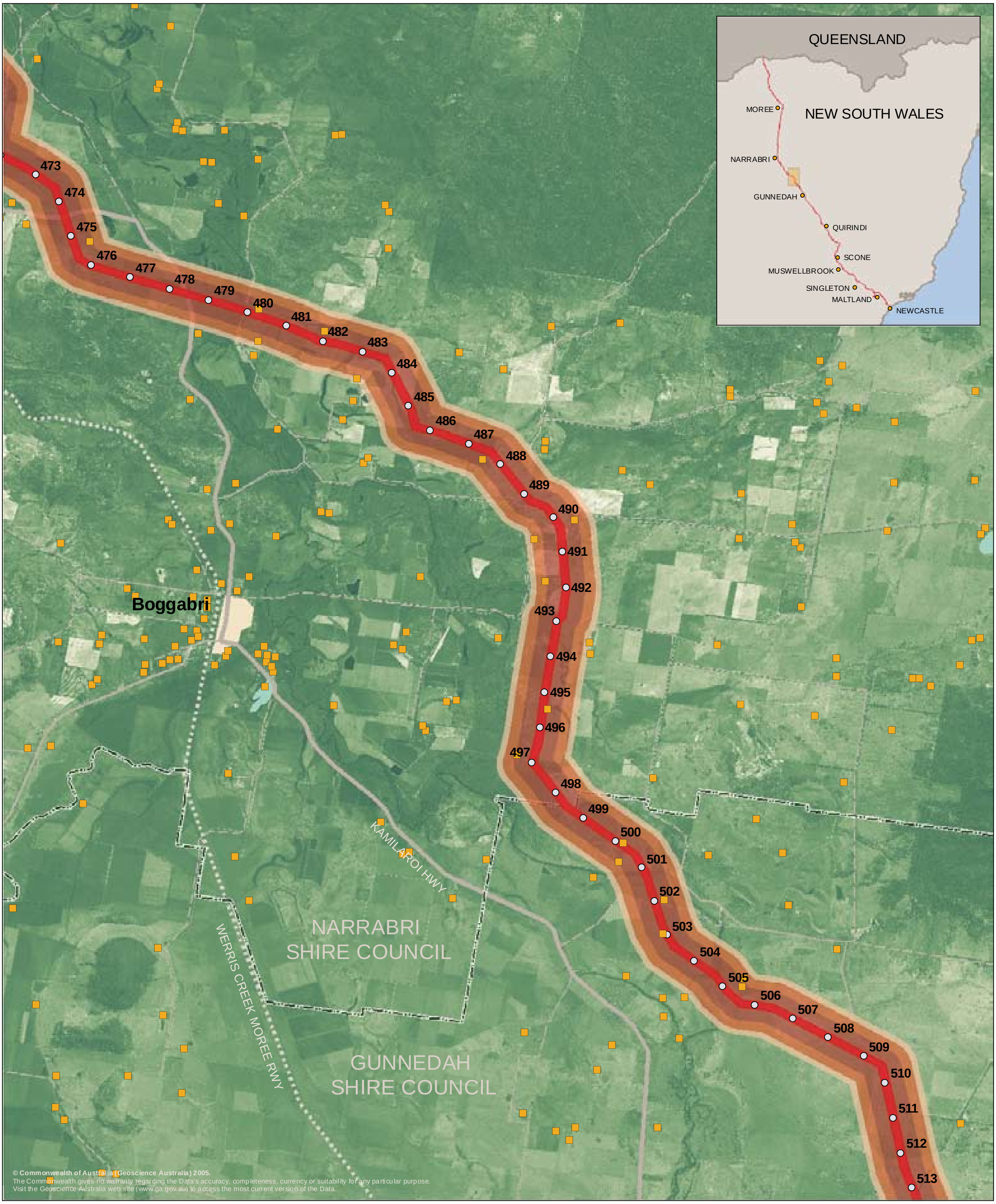
- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.7 Human receptors - Narrabri area



Drawing no. 07002g_CP_HA_08-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- Built up area
- LGA boundary

Isolated residences potential noise impact:

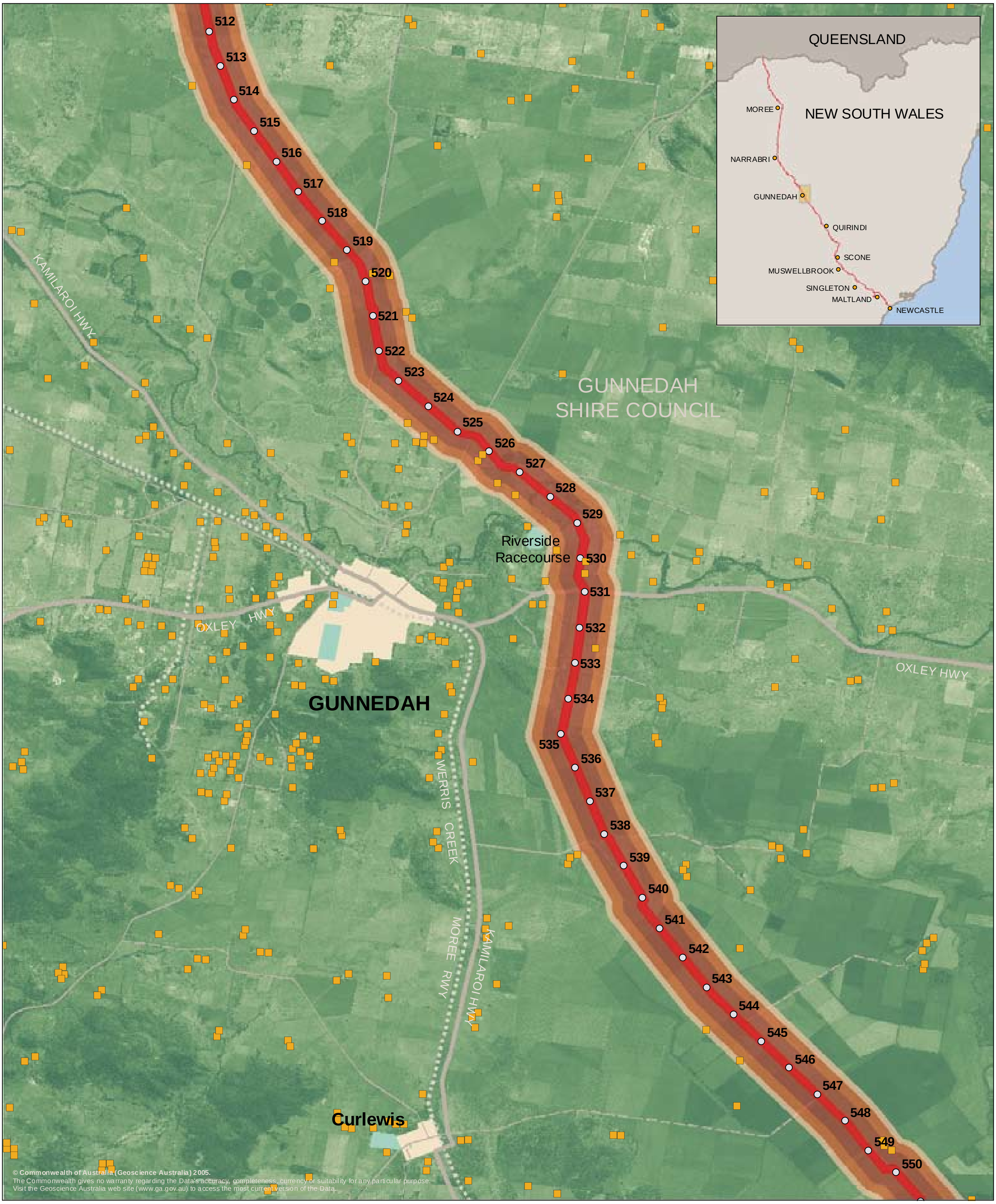
- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.8 Human receptors - Boggabri area



Drawing no. 07002g_CP_HA_09-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- Built up area

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.9 Human receptors - Gunnedah area

Drawing no. 07002g_CP_HA_10-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- LGA boundary

Isolated residences potential noise impact:

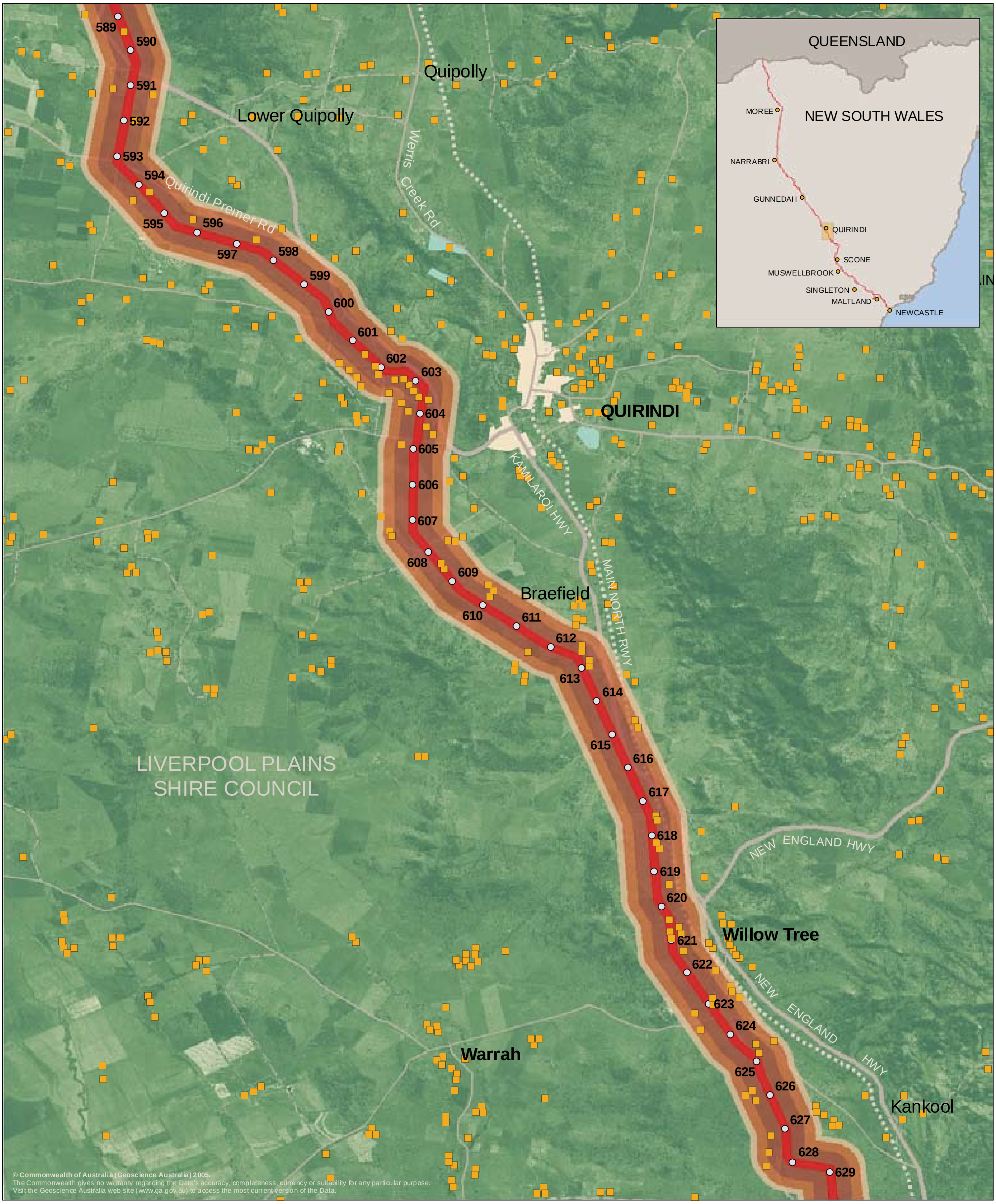
- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.10 Human receptors - Breeza area



Drawing no. 07002g_CP_HA_11-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- Built up area

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.11 Human receptors - Quirindi area

Drawing no. 07002g_CP_HA_12-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Proposed pipeline corridor
- Isolated residence
- Built up area
- LGA boundary
- Hospital

Isolated residences potential noise impact:

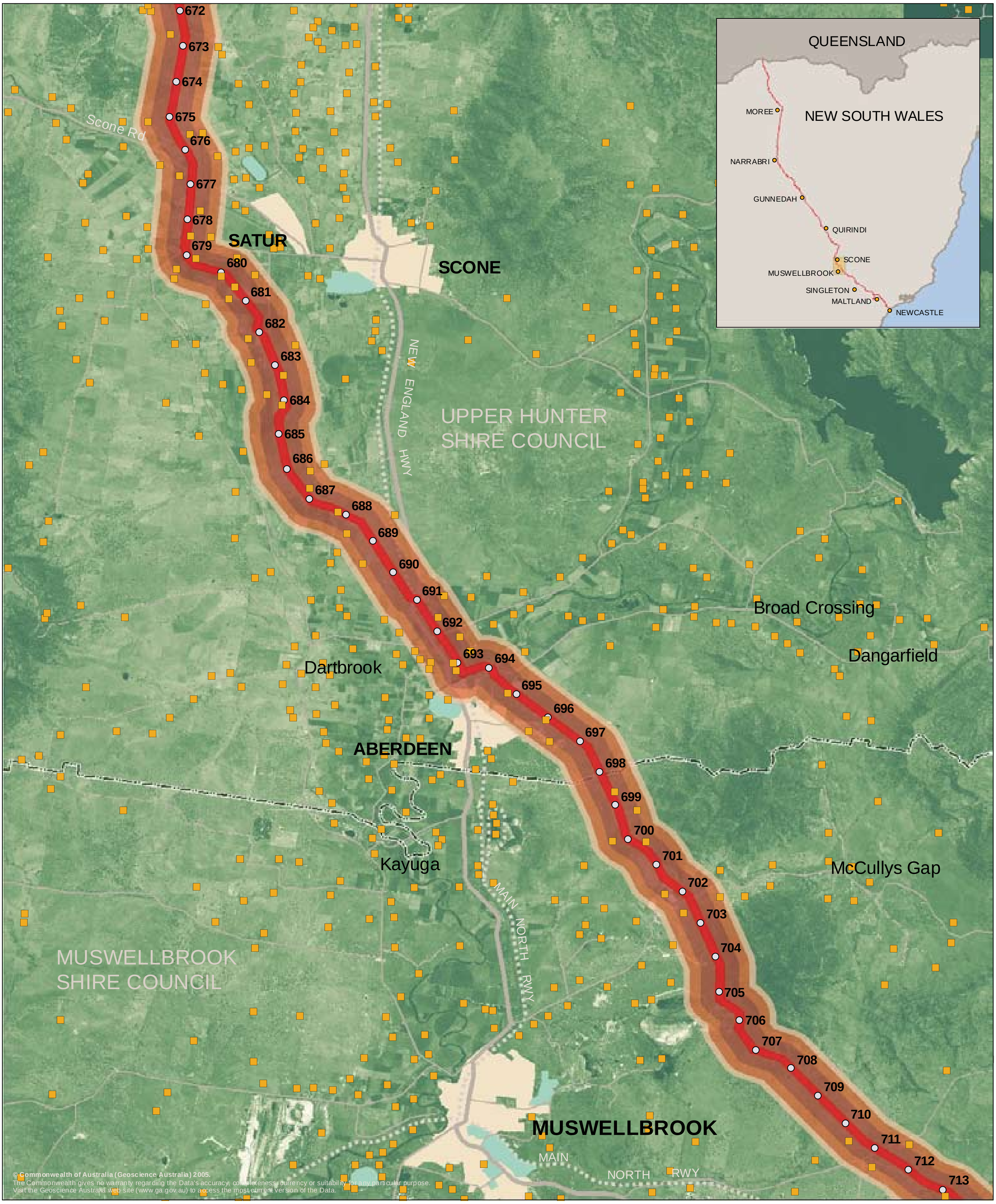
- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.12 Human amenity - Murrurundi area



Drawing no. 07002g_CP_HA_13-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- Built up area
- LGA boundary

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.13 Human receptors - Muswellbrook area

Drawing no. 07002g_CP_HA_14-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- LGA boundary

Isolated residences potential noise impact:

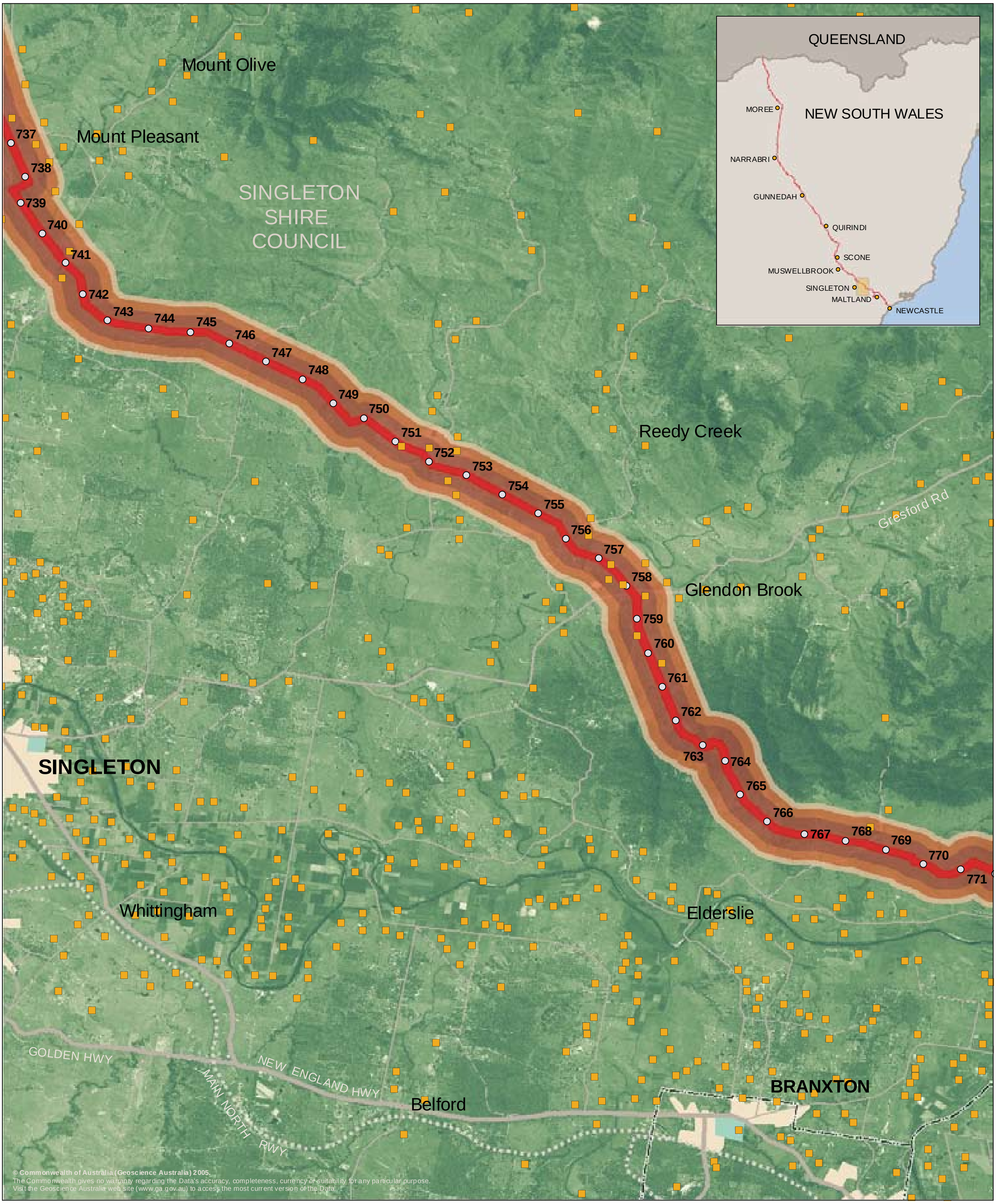
- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.14 Human receptors - Singleton north area



Drawing no. 07002g_CP_HA_15-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Built up area
- Recreation area
- LGA boundary

Isolated residences potential noise impact:

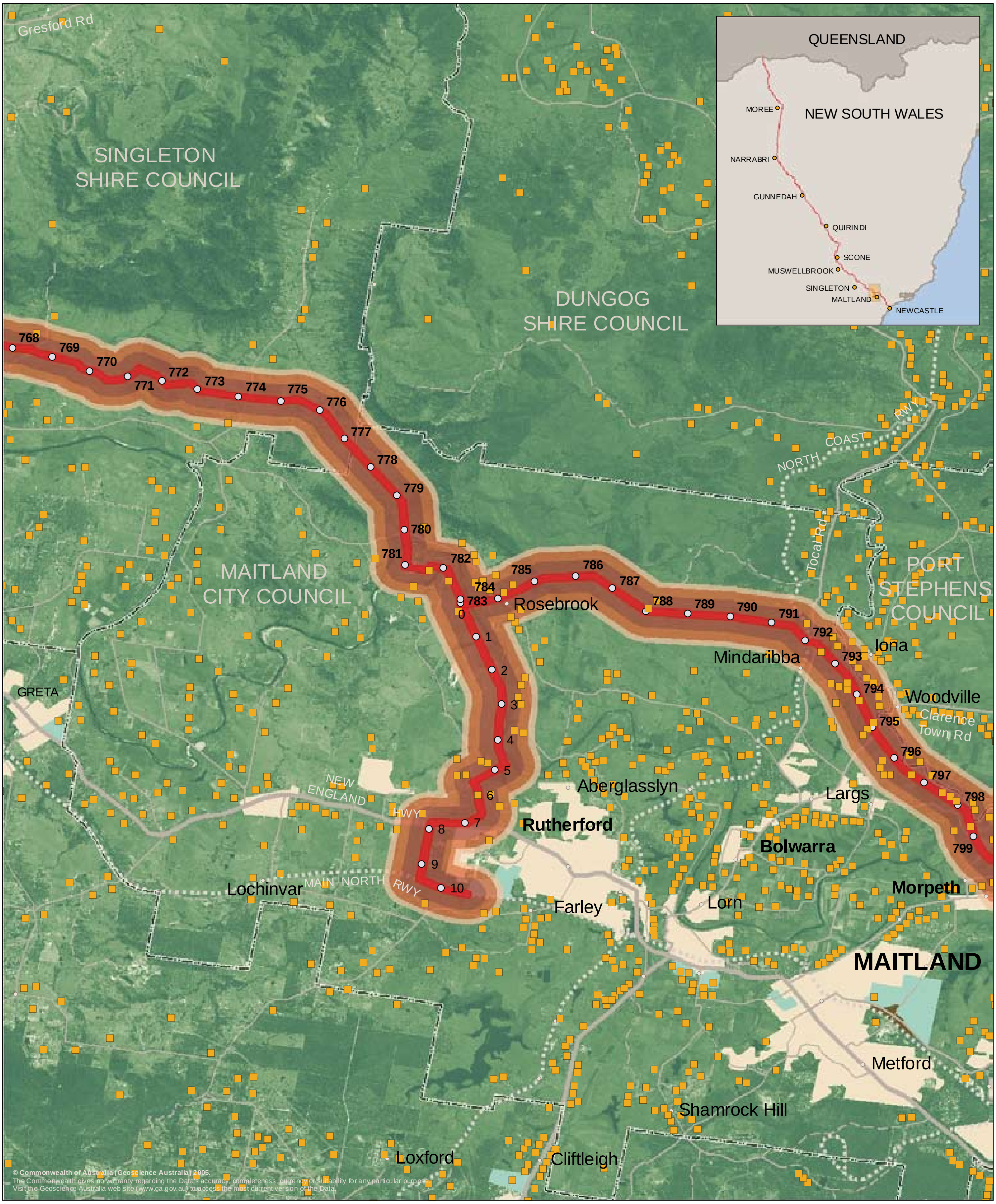
- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.15 Human receptors - Singleton east area



Drawing no. 07002g_CP_HA_16-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Cemetery
- Recreation area
- Built up area
- LGA boundary

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 11.16 Human receptors - Maitland area

Drawing no. 07002g_CP_HA_17-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Isolated residence
- Recreation area
- Cemetery
- Built up area
- LGA boundary

Isolated residences potential noise impact:

- Major (350m offset) +20dBA
- Moderate (600m offset) +10dBA
- Minor (750m offset) +5dBA

Queensland Hunter Gas Pipeline

Figure 11.17 Human receptors - Newcastle area

1:140,000 (at A4)

0 1 2 3 4km

11.3 Noise and vibration

11.3.1 Assessment methodology

Potential noise and vibration impacts associated with the proposal has been assessed by Heggies Pty Ltd (Heggies), and are appended to this report as Appendix G. Noise, vibration and blasting were assessed based on a qualitative approach, which adopted a tiered impact assessment to determine noise off-set distances and identify potential noise receptors within the off-set region. The qualitative noise assessment comprised:

- A review of the proposed construction activities to identify those activities likely to generate significant noise. Construction parameters taken into consideration include proposed plant and equipment, hours of operation and duration of each construction stage.
- An assessment of potential noise impacts from the identified construction activities.
- The development of off-set distances from the proposed construction activities using proposal-specific significance criteria (major, moderate and minor) based on DECC guidelines in the *Environmental Noise Control Manual*.
- The identification of sensitive receptors (eg isolated residences, residential zones) within off-set distances that could experience construction noise emission exceedances.
- The examination of all reasonable and feasible noise, vibration and blast mitigation measures including the use of alternative construction methods where potential major noise, vibration or blast emission impacts were identified.

11.3.2 Existing environment

For the majority of its length, the pipeline would be located away from populated centres and rural residences. It does, however, pass adjacent to a number of towns and, dependant on the separation distances, may cause noise impacts during construction and operation. The Study Area passes the rural towns of Moree, Narrabri, Gunnedah, Aberdeen, Murrurundi, Scone, Muswellbrook, Singleton, Maitland and to the immediate north of the city of Newcastle. As the Study Area approaches Newcastle there is increased likelihood of encountering sensitive receivers.

In the absence of measured background noise levels, conservative background levels (rated background levels) of 30dBA for isolated residences and 35dBA for rural and semi-rural towns have been used to determine noise emission criteria. This is consistent with DECC's *Environmental Noise Control Manual*.

11.3.3 Noise and vibration criteria

Noise

The DECC's *Environmental Noise Control Manual* provides the following criteria for consideration in determining noise limits for a project:

- For a cumulative period of exposure to noise from construction activity of up to four weeks in duration, the $L_{A10(15\ minute)}$ noise level emitted by the works, when measured at a residential receiver, should not exceed the $L_{A90(15\ minute)}$ rated background level by more than 20dBA.
- For a cumulative period of exposure to noise from construction activity of between four weeks and 26 weeks in duration, the $L_{A10(15\ minute)}$ noise level emitted by the works, when measured at a residential receiver, should not exceed the $L_{A90(15\ minute)}$ rated background level by more than 10dBA.

For a cumulative period of exposure to noise from construction activity greater than 26 weeks in duration, the $L_{A10(15\ minute)}$ noise level emitted by the works, when measured at a residential receiver, should not exceed the $L_{A90(15\ minute)}$ rated background level by more than 5dBA.

Based on the DECC criteria and the assumed background levels (refer to Section 11.3.2) proposed construction noise criteria have been determined (Table 11.2). These have been set to correspond to potentially major, moderate and minor impacts with reference to the DECC's *Environmental Noise Control Manual* and recognising that intensive activities would generally occur for periods of less than one month near any single receiver.

Table 11.2 Construction noise criteria – $L_{A10(15\ minute)}$ noise levels

Receivers	Major (background + 20dBA)	Moderate (background + 10dBA)	Minor (background + 5dBA)
Isolated residences	50dBA	40dBA	35dBA
Township residences	55dBA	45dBA	40dBA

Note: Assumes L_{A90} rate background levels for isolated rural residences are 30dBA and 35dBA for residences in rural and semi-rural towns.

Vibration

Potential sources of construction vibration would be from bulldozing, rock sawing, and blasting from trench excavations. Project specific vibration criteria have been set that correspond to potentially major, moderate and minor impacts based on guidelines for cosmetic building damage and human comfort as shown in Table 11.3.

Table 11.3 Construction vibration criteria

Receptor	Peak component vibration velocity[1]		
	Major impacts	**Moderate impacts**	**Minor impacts**
All residences	10mm/s	5mm/s	1.6mm/s

Note: based on compilation of relevant limits from German Standard DIN 4150-3: 1999, DECC's "Assessing Vibration: a technical guideline", and British Standard 7358: Part 2-1993.

11.3.4 Potential impacts

Construction

Noise

Noise from the pre-construction studies would be negligible and transient involving very small numbers of people and vehicle movements.

Potential noise impacts that may result from construction of the proposal include:

- Noise created by pre-construction studies, such as geotechnical surveys, vehicles and aircraft.
- Noise created by construction teams and associate machinery, including camps.

Receivers would only be affected during construction activities. Pipeline construction is transient in nature, whereby construction crews complete specific activities intermittently along the ROW. Noise and vibration would primarily be generated by bulk excavating machinery, such as bulldozers and chain or wheel trenchers. In hard rock areas blasting would also be required (see below).

In order to assess the noise impacts of the various pipeline construction activities, noise emission calculations were carried out to determine distances at which the construction noise criteria were exceeded. These calculations were based on typical noise emission levels of machinery, measured in field studies on large construction projects. It is noted that the calculations assume propagation over flat, soft ground (ie open grassland) to a typical receiver. As the construction noise is anticipated to be over a relatively short distance, the noise level calculations do not include any meteorological enhancement, such as a slight breeze towards the receiver, or temperature inversion. The noise-affected distances determined from the analysis are summarised in Tables 11.4 and 11.5.

Table 11.4 Off-set distances corresponding to noise criteria – isolated residences

Construction phase	Associated equipment	Off-set distance to residence (metres)		
		Major impacts	Moderate impacts	Minor impacts
Preparation of right of way	Bulldozers, graders, backhoes	280	525	680
Trench excavation	Chain trencher, excavator	350	600	750
Pipe preparation	Grit blasting	220	420	560
Pipe laying and reinstatement	Side boom tractors, graders, rollers	200	400	520
Horizontal directional drilling	Horizontal directional drilling rig	220	420	560
Misc works	Daymakers, pumps, generators	120	260	370

Source: Heggies, 2008.

Note: The distance is calculated based on the expected summation of noise sources at the receiver for the noisiest activity. Depending on the scenario, the level may result from the noisiest operation, or be from multiple sources. As L_{A10} levels are statistical they cannot simply be summed.

Table 11.5 Off-set distances corresponding to noise criteria – township residences

Construction phase	Associated equipment	Off-set distance to residence (metres)		
		Major impacts	Moderate impacts	Minor impacts
Preparation of right of way	Bulldozers, graders, backhoes	200	400	525
Trench excavation	Chain trencher, excavator	250	480	600
Pipe preparation	Grit blasting	140	300	420
Pipe laying and reinstatement	Side boom tractors, graders, rollers	200	280	400
Horizontal directional drilling	Horizontal directional drilling rig	140	300	420
Misc works	Daymakers, pumps, generators	75	180	260

Source: Heggies, 2008.

Note: The distance is calculated based on the expected summation of noise sources at the receiver for the noisiest activity. Depending on the scenario, the level may result from the noisiest operation, or be from multiple sources. As L_{A10} levels are statistical they cannot simply be summed.

The noisiest activity identified in these calculations is trench excavation. Corresponding off-set distances are 750m, 600m and 350m for major, moderate, and minor impacts for isolated receivers and 600m, 480m and

250m for major, moderate, and minor impacts for township receivers. For the purposes of the noise assessment, impacts for sensitive receptors were assessed against the off-set criteria for isolated receivers.

Table 11.6 summarises the number of receptors, using the off-set criteria as noted above and the receptor analysis methods as outlined in Section 11.2.3, for major, moderate and minor impacts relating to isolated, sensitive and residential receptor types. The location of the identified receptor types and the worst-case noise limits are shown in Figures 11.1 to 11.17.

Table 11.6 Noise impact and receptor type

Receptor type	Noise impact (off-set criteria)	Details
Isolated residences	Major noise impact (350m)	272 isolated residences.
	Moderate noise impacts (600m)	165 isolated residences.
	Minor noise impacts (750m)	105 isolated residences.
Sensitive receptors	Major noise impact (350m)	• Multiple use' area (three areas identified). • Westside Golf Course. • Wilson Memorial Hospital (Murrurundi).
	Minor noise impacts (750m)	• Riverside Racecourse. • Westside Golf Course. • Multiple use' areas.
Residential receptors	Major noise impacts (250m)	• Tomago. • Murrurundi. • Maitland (outskirts only). • Aberdeen. • Ravensworth. • Burilda. • Ardglen. • Rosebrook. • Camurra.
	Moderate noise impacts (480m)	• Kooragang. • Pangela. • Boonal. • Greenland. • Maitland. • Murrurundi. • Newcastle. • Aberdeen. • Tomago.
	Minor noise impacts (600m)	• Morpeth. • Turilawa. • Moppin. • Turrawan.

The noise assessment shows that larger town centres, such as Moree, Narrabri, Gunnedah, Scone, Muswellbrook and Newcastle are not likely to be impacted from noise by construction of the proposed pipeline. This has been achieved through avoidance of regional towns during the development of the pipeline route, as outlined in Chapter 3. Rural population densities or isolated residences are likely to be impacted by noise, however, due to the transient nature and short duration of the works in any one area the impact should be minimal.

Construction works would be undertaken between 7am and 6pm, seven days a week for 28 days and then nine days off. There are, however, instances where extended construction hours may occur and this is outlined in Section 5.3.1.

Work extending into nighttime hours could impact on ambient noise levels with the potential to create sleep disturbance in nearby residences. The movement of plant, equipment and pipe may also have similar impacts, however, because truck movements would only pass through the affected areas, potential impacts would be considered transient. Potential impacts from operations of the construction camps would be minimal as the location criteria requires the distance of construction camps to be 500m from dwellings or any other sensitive receivers (refer to Table 5.5).

Vibration

Typical ground vibration levels from construction activities would range from 1mm/s to 2mm/s at a distance of approximately 5m. At distances greater than 20m, vibration levels are usually below 0.2mm/s. Safety criteria for pipelines would ensure that receptors are not within 5m of the pipeline. Therefore, the expected vibration levels from normal construction activities would not cause structural damage to buildings. However, vibration levels from blasting may have potential impacts on the buildings further than 5m.

Blasting

Blasting would be required for trench excavation in areas of hard rock that cannot be rock sawed. Hard rock is present for approximately 45km of the Study Area. At this stage of assessment, blasting is anticipated through the areas of the Liverpool Ranges and in some areas along the northern edge of the Hunter Valley region.

Vibration levels for blasting are higher than that of normal construction activities. Potential impacts to buildings during blasting through vibration or stray debris may cause structural damage to buildings. Damage includes vibration levels weakening the existing foundations of buildings, and causing visible cracks on walls.

Blasting would normally generate impacts in the form of audible and sub-audible noise and vibration and regenerated noise. The extent of these impacts can be controlled to a large extent by the experience of the blasting contractor and the activity would be undertaken in accordance with the following guidelines:

- DECC *Environmental Noise Management Manual Chapter 154*.
- *APIA Code of Environmental Practice*, Section 4.5.1 Blasting.
- *Australian Standard 2187.2 – 2006*: Explosives – Storage and use of explosives.
- *Australia and New Zealand and Environment Conservation Council* (ANZECC) (1990) Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration.
- *German Standard DIN 4150-3*, 1999–02 Vibration in buildings – Part 3: Effects on structures.
- *British Standard* BS 6472-1992.

General recommendations for overpressure (air blast) are limits of 115dB (peak) at receivers and that ground-borne vibration is limited to a maximum level of 5mm/s at the nearest dwelling.

Blasting parameters and design have not been finalised at this stage. Assuming employment of drill and blast techniques incorporating confined blasting, the complying distance from the blasting site would typically be 250m (using the criterion of 115dB airblast and 5mm peak particle ground velocity). This has been taken into consideration in selecting the Study Area through hard rock areas.

Operation

Potential noise impacts during the operational period may be generated by:

- Vehicles and machinery travelling along the pipeline ROW and access tracks.
- Maintenance at above-ground sites.
- Venting of gas at MVLs for planned maintenance or emergency situations (however these situations are rare).
- Equipment noise at above-ground sites, from pigging and meter stations.

Such activities would be intermittent and of short duration, and would not create any long term noise impact to receptors. Impacts related to these noise emissions include the potential disturbance to local residents, other land users and stock and wildlife.

There are no adverse noise impacts anticipated with the operation of the pipeline, with the exception of an emergency gas release (this would take place at the MLVs). The occurrence of emergency venting would be extremely infrequent, if at all, and MLV locations would be planned to minimise the potential for noise impacts.

Operational activities associated with the pipeline would have limited, if any, potential to generate vibration.

11.3.5 Proposed mitigation and management measures

Construction

Noise and vibration impacts as a result of the proposal during construction are unlikely to be significant, and would be manageable through the implementation of standard mitigation measures provided in Table 11.7. These mitigation measures would be included in the CEMP.

Table 11.7 Noise and vibration mitigation and management measures during construction

Potential impacts	Mitigation and management measures
Pre construction	
Vibration damage to buildings during construction	• Buildings and structures that would require a condition survey would be identified prior to the commencement of rock breaking and blasting activities.
During construction	
Rock blasting annoyance	• Controlled blasting techniques would be employed where feasible. • Rock blasting would be scheduled to occur between 9am and 5pm Monday to Saturday. No blasting will occur on Sundays and public holidays. • Test blasts would be implemented at locations furthest from residential receivers and measurement of noise and vibration levels at the nearest structures would be undertaken. • The ANZECC criteria for noise from blasting would be employed; meeting this guideline would provide adequate protection from vibration exceedance. • Blasting mats would be used wherever possible to minimise dust and stray debris. • Adopt management practices consistent with Section 4.5.1 of the APIA Code.

Potential impacts	Mitigation and management measures
Increased noise impact on nearby residences	• Regularly inspect, test and maintain all stationary and mobile plant and equipment to ensure that noise emission levels do not deteriorate over the construction period. • Provide affected receivers (isolated residences, sensitive, hospitals and schools within 350m of the construction activities and built up areas within 250m of the construction activities) with a contact name and number for ongoing liaison. • A procedure would be established for maintaining contact and responding to all calls within 24 hours. • Prior to the commencement of nighttime activities, affected receivers (isolated residences, sensitive, hospitals schools etc within 350m of the construction activities and built up areas within 250m of the construction activities) would be provided with a minimum of two days notice of the hours of work, likely impacts associated with these activities and a 24-hour contact point. • To the greatest degree practicable, nighttime activities that are expected to increase ambient noise levels must be scheduled to occur before midnight. • Site inductions would include appropriate behaviour on site to minimise disruptive noise (example no shouting, slamming doors etc), particularly during night works. • Reasonable and feasible measures would be implemented to ensure that potential impacts on affected residences are minimised. This might include noise abatement equipment (such as temporary noise barriers), noise reduction measures (such as the provision of ear muffs) or temporary relocation.

Operation

The potential impacts and mitigation measures during operation are set out in Table 11.8.

Table 11.8 Noise mitigation and management measures during operation

Potential impacts	Mitigation and management measures
During operation	
Increased noise impact on nearby residences from operation of above ground infrastructure	• During detailed design, above-ground infrastructure would be located to ensure the relevant requirements of the *NSW Industrial Noise Policy* (EPA, 2000) are met.
Increased noise impact on nearby residences from maintenance activities	• Where practicable, noisy activities would be scheduled for periods that are less likely to result in noise nuisance, and in consultation with affected residents. • Local residents shall be notified of potential noise from maintenance or proposed activities prior to the commencement of such activities. • A procedure shall be established for maintaining contact with affected landowners and responding to all contact made. • Noise monitoring shall be conducted if requested by DECC as the result of ongoing concerns.

11.4 Air quality

Air quality impacts associated with the proposal were assessed by Heggies, and are appended to this report as Appendix H.

Operational management measures relating to gas release have been included in this chapter as they relate to air quality impacts. Gas release has also been reviewed from two other perspectives within this EA: in terms of hazards and risks (Chapter 14) and greenhouse gas and climate change (Section 17.5).

11.4.1 Assessment methodology

Air quality criterion are provided in Appendix H. Due to the transient nature of construction activities, air quality modelling has not been performed, as modelling needs to take into consideration factors such as wind speed and the variability of wind direction. These factors are indeterminate for this assessment due to the linear scope of the proposal and shifting time frames for construction. However, a review of typical construction activities was undertaken to determine the generation estimates of emissions, including nuisance dust, total suspended particulate (TSP), particulate matter less than ten microns (PM10), and particulate matter less than 2.5 microns (PM2.5). Therefore the air quality standards provided in Appendix H have been included as guidelines only and should not to be compared to the estimated emissions for construction activities.

Relevant guidelines in relation to air quality were considered to develop appropriate management and mitigation measures that could be included within the CEMP.

Potential air quality impacts and management measures during operation of the proposed pipeline have also been considered. This has been informed through reference to the APIA Code.

11.4.2 Existing environment

The ambient air quality environment will vary across the Study Area according to each region and land use, ranging from that typical of an urban environment (Newcastle City), to areas impacted by mining activities (Hunter, Narrabri, Boggabri) and remote rural locations. In rural locations the main existing sources of air pollution will be dust storms, unsealed roads, exposed dry areas, bushfires and agricultural activities.

The meteorological environment is also likely to vary considerably along the Study Area, and temporal and spatial variations can be expected as the pipeline construction spreads progress. In many of the rural areas, the meteorological environment will largely be influenced by prevailing conditions; for example dust storms during high winds and dust suppression during precipitation.

Local prevailing conditions would be monitored by site personnel, in accordance with mitigation and management measures to identify, manage and respond to unfavourable site-specific wind conditions.

11.4.3 Potential impacts

Construction

Key potential impacts during construction include:

- Air emissions associated with the combustion of fuel in vehicles, plant and equipment.
- Dust from earthmoving equipment activities and transport.

Air emissions

Truck and heavy plant movements will be required during construction to deliver pipe, plant and equipment to the construction ROW. Heavy construction plant movements, and the associated emissions, will be distributed spatially and temporarily along the site on a daily basis. It is anticipated that two pipeline construction spreads would be simultaneously mobilised for construction over the total length of the pipeline. It is estimated that there will be a movement of 26 pipe delivery trucks per spread per day (refer to Table 11.12). Other truck movements (refer to Section 11.5) will be for limited periods during mobilisation and demobilisation of plant, equipment and camps.

Vehicle exhaust emissions of oxides of nitrogen (NO_X), sulphur dioxide (SO_2) and hydrocarbons would be distributed within the pipeline ROW and are expected to be easily assimilated into the local air shed. Additionally, the low sulphur content of Australian diesel is expected to ensure air quality goals for SO_2 would be met at the nearest sensitive receivers. Therefore the total volume and distribution of heavy vehicle traffic is not expected to generate sufficient vehicle exhaust emissions to compromise air quality goals in any locations.

Dust

The principal emissions from construction activities would be dust and particulate matter from earth moving activities and transport on unsealed roads and tracks during dry conditions. The extent of the impact would vary depending upon soil type, the prevailing wind conditions at a given location, and wetness.

The following activities are those identified as a specific potential source of dust generation during construction:

- Vegetation clearing, trenching, backfilling and reinstatement.
- Wind erosion from stockpiling of excavated material – topsoil and trench spoil.
- Movement of vehicles and construction machinery, both within and in/out of the construction site.
- Use of the padding machine.
- Drilling and blasting at hard rock areas.

A summary of the estimated emissions from typical construction equipment is provided in Table 11.9. This is based on typical emissions for standard earth moving equipment and assuming that each piece of equipment is operated for a period of ten hours/day. It should be noted that emissions from a padding machine may have been over estimated as they were calculated based on a combined emission factor for screening, conveying and unloading. Reference should be made to Appendix H for further assumptions used in relation to the determination of emissions.

Table 11.9 Summary of emission generating construction activities

Activity	TSP Emissions (kg/day)	PM_{10} Emissions (kg/day)	$PM_{2.5}$ Emissions (kg/day)
Dozer	51	7	1
Excavator/ditcher/front end loader	1.2	0.6	0.1
Vehicle movements	143	44	4.4
Grader	27	9	0.9
Padding machine	281	181	27.1
Wind erosion	29	14	2.2
Drilling and blasting (without mats)	195	101	10.2

Source: Heggies, 2008

While construction equipment and timing of activities may be subject to change, the above estimations are useful to determine the relative contribution of various sources to the overall dust expected at the site.

In summary, the data in Table 11.9 identifies that certain activities have greater potential for dust generation than others. The key dust generators are: the padding machine, vehicle movements, and dozer activities.

Blasting is also an activity with a significant potential for dust generation. However, this activity will only occur in limited locations where the pipeline route intersects hard rock. This has been estimated to affect approximately less than ten per cent (45km) of the Study Area and, therefore may not be potentially significant compared to other construction activities.

Operation

During operation, as the pipeline would be buried and maintenance activities are generally passive, it is unlikely that air quality would be affected. The ROW would be rehabilitated after construction minimising the potential for dust generation. Dust issues arising from vehicle and equipment movement during maintenance operations are considered to be negligible and should not create any long term or permanent impact on air quality in a region.

Air emissions that may have an adverse impact on air quality during the operation of the pipeline include:

- Fugitive emissions of gas due to maintenance activities, such as pipeline purging.
- Emergency venting of gas that may impact the air quality for a limited period in a specific location, generally at a MLV location.

11.4.4 Proposed mitigation and management measures

Construction

Mitigation measures would be implemented depending on site conditions at a particular location and the proximity of sensitive receivers. Mitigation measures that would be implemented during construction and incorporated into a CEMP, are outlined in Table 11.10.

Table 11.10 Air quality mitigation and management measures during construction

Potential impact	Mitigation and management measures
Reduction in air quality from dust and particulate matter	The following dust management measures would be implemented to minimise nuisance dust: • Reduce speed limits during high dust conditions. • Clearing of vegetation and topsoil would be limited to the designated footprint required for pipeline construction. • Progressive reinstatement would be undertaken as the pipeline construction proceeds. • Water trucks would be employed to reduce dust in dry windy conditions. • Silt and other materials would be removed from around erosion control structures following any significant rain event to ensure deposits do not become a dust source.
	Working practices would be modified during periods of high winds by limiting the use of some machinery, particularly when in close proximity to dwellings, and reducing travel speeds.
	Blasting would be conducted at appropriate times, with consideration of site conditions and sensitive receivers.
	The burning of material on site would be prohibited, except under the instruction of fire services.

Potential impact	Mitigation and management measures
Emissions from plant and equipment	Vehicles would be maintained to ensure emissions are kept to the minimum practicable.

Given the short-term duration of the construction spreads, ambient air monitoring is not deemed necessary for the construction of the QHGP. However, daily visual checks would be undertaken to ensure that operational safeguards are effective and are being adhered to by construction staff and contractors.

Environmental management of the proposal will be overseen by the site environmental representative (ER) who will be responsible for liaison with other on-site personnel and for reporting on the adherence to the CEMP.

All site personnel and subcontractors would undergo appropriate induction training including individual responsibilities for ensuring that procedures are adhered to.

Operation

Mitigation measures would be implemented appropriately depending on site conditions at a particular location and the proximity of sensitive receivers. Some generic mitigation measures that would be implemented to minimise air quality impacts during operation are outlined in Table 11.11.

Table 11.11 Air quality mitigation measures during operation

Potential impact	Mitigation and management measures
Release of air pollutants from fugitive gas emissions	Regular maintenance checks, in accordance with AS2885.3 would be undertaken to ensure containment of the gas within the pipe network system.
	All valves would be regularly maintained.
	Installation of a leak detection system, to monitor gas leaks that may affect the integrity of the gas pipeline.
Release of air pollutants from gas venting	The planned venting of gas would be limited at all times. This is because generally gas that does not conform to the specifications of the requisite gas supply for the QHGP would not be accepted. It is also not in the interests of the pipeline operator to vent gas, as this is costly.
	Should gas venting be undertaken, it would be undertaken, where practicable, under favourable metrological conditions (ie to facilitate rapid atmospheric dispersion of the gas).

11.5 Traffic and transport

Potential traffic and transport impacts associated with the proposal were assessed by Traffic and Transport Planning Associates Pty Ltd (TTPA) and are appended to this report as Appendix I. The following section summarises the key findings from the TTPA report.

11.5.1 Existing environment

The pipeline will involve a number of road crossings as discussed in Chapter 16. These roads vary from minor rural roads to major highways. There are a number of major highways that would be used as transport routes for plant and equipment during the construction of the QHGP proposal.

The major highways include:

- Pacific Highway.
- Oxley Highway.
- Newell Highway.
- New England Highway.
- Kamilaroi Highway.
- Gwydir Highway.
- Gresford Road.
- Carnavon Highway.

11.5.2 Potential impacts

Construction

Potential impacts on the road network during the construction period would involve four components:

- Mobilisation and demobilisation of construction plant, equipment and camps.
- The transportation of pipe sections to and along specific sections of the pipeline ROW.
- Construction activity at or near a road.
- The movement of the workforce between the ROW and the accommodation facilities.

No truck movements are anticipated to arise from transportation of spoil from trench excavation activities. Trench material would be stockpiled and used for backfill during reinstatement, with only the volume taken by the pipe remaining. As far as practicable this would be distributed over the excavation area and compacted to match the former ground levels. Any excess material not able to be used in this way would be stockpiled in suitable locations for ongoing maintenance during operations. Stockpile locations would be determined in consultation with the relevant landowners and would not be in the vicinity of watercourses or drainage areas.

In rocky areas requiring blasting, some padding material (soil or sand) may have to be transported to the site. This would be put into the trench to keep the pipe off the sharp rocks and around and over the pipe to keep the back filled rubble from damaging the pipe. The use of foam padding would miminise the amount of padding to be brought in.

The method of transport for all construction related activities has not been determined and will depend upon factors such as the availability of plant, equipment and pipe supplies. The method of transportation would be determined by the construction contractor taking into consideration road, rail or a combination of both. The final choice will be based on the most practicable, efficient and cost effective means available depending upon the supply and delivery locations.

Table 11.12 outlines vehicle movements per construction spread for activities that may have a potential impact on existing traffic and transport levels.

Table 11.12 Estimated vehicle movements per spread during construction

Activity	Vehicle movements
Mobilisation and demobilisation of plant and equipment to the site.	• 110 trucks (35 tonne trucks).
Mobilisation and demobilisation of construction camps.	• 90 semi-trailer loads (15 and six tonne trucks).
Transportation of pipe sections to temporary storage facilities.	• This will include a combination of road and rail delivery. The CEMP would identify the locations of temporary storage facilities and the locations of adequate rail sidings. This would determine the estimated number of truck movements required.
Transportation of pipe sections from temporary storage facilities to the ROW.	• 26 trucks per day one-way (24 tonne trucks).
The transportation of activities between the ROW and accommodation facilities.	• 60 light vehicles (mainly 4WDs) that will be used to transport up to 300 personnel daily, one-way. • 25 trips per day for water cartage. • Three trips per day for fuel deliveries. • Two trips per day for camp service and waste disposal. • Two trips per day for floating equipment around the construction ROW.

The estimated numbers in Table 11.12 allow for any potential impacts from vehicle movements to be identified and will be used in relation to the four components outlined in the following sections.

Mobilisation and demobilisation of plant, equipment and construction camps

Typical equipment used in pipeline construction includes: bulldozers, graders, trucks, excavators, loaders, side-boom tractors, padding machines and wheel ditching machines. Whilst the bulk of the earthmoving equipment (eg excavators, graders, water trucks) would generally be sourced locally, specialist plant and equipment (eg pipe bending machines, side booms and padding machines) may be sourced from interstate.

Plant and equipment may arrive either by road, rail or a combination of both, however the source and timing of mobilisation and demobilisation of plant, equipment, camp facilities and heavy vehicles varies, usually making road transport the most viable option. As outlined in Table 11.12 the estimated vehicle movements for delivery of plant and equipment to the site is 110 truck movements of around 35 tonnes each. The estimated vehicle movements for mobilisation and demobilisation of construction camps is 90 semi-trailer loads (15 and six tonne trucks).

Once delivered to the start of each pipeline spread, all plant, equipment and many heavy vehicles would travel almost exclusively along the ROW from the start to the finish. The likely exceptions to this would be:

- Transport around major rivers or physical obstacles.
- Special crews, such as HDD and hydrostatic pressure testing whose work is not contiguous.
- Line pipe haulage.
- Daily servicing of work crews and equipment.
- Water haulage for dust suppression and camp water supply.

Potential impacts from mobilising and demobilising equipment relates directly to traffic generation. The main impacts would be traffic increases on local (minor) road networks and in areas with low existing traffic volumes. Impacts to major highways as a result of traffic movements are considered negligible in comparison to the existing heavy vehicle traffic volume on these routes.

The transportation of pipe sections to and along the pipeline ROW

Pipe sections would be transported to the ROW sequentially as follows:

- Pipe delivery – Pipe would be delivered to pipe storage facilities set up to service the proposed construction spreads and would be transported by road, rail or a combination of both. Each pipe storage facility will have a stock of approximately 50km and the pipe would be transported intermittently and constantly to the storage facilities throughout the construction phase.
- Pipe to the ROW – Pipe would be delivered to the ROW from the pipe storage facility by road. Pipe may be taken directly to the ROW, ready for laying into the trench, or, in rare cases temporarily stored at the construction camp. The method of pipe delivery is dependent on the progress and scheduling of the construction spread crews.

Refer to Figure 11.18 for an outline of the delivery process.

Figure 11.18 Delivery process

It is estimated that approximately 620 tonnes per day of pipe would be required to be delivered to each spread. Based on a 24 tonne capacity this equates to approximately 26 vehicles (one-way) per spread, per day.

The main impact on traffic generation relates to the movement of vehicles from the pipe storage facility to the ROW. Transportation access routes are likely to be minor roads, and an increase in vehicles would be noted in these types of roads. In order to determine the impact of these vehicle movements and to establish site specific mitigating measures, the location of the pipe storage facilities would need to be identified closer to the time of construction in the relevant local area.

Construction activity at or near a road

The Study Area transects and is parallel to a number of roads. These locations are discussed in Chapter 16.

The typical crossing details for the various road types include:

- Highways – the pipe will be bored beneath the highway crossings.
- Major road – boring would be conducted at most major road crossings. Consideration would be given to trenching where traffic generation is noted as being minor.
- Minor road – trenching will be conducted at all minor road crossings.

The potential impacts on road crossings include traffic delays due to construction activities (eg trenching, and the transport of plant and equipment across the road) and reduced speed limits, especially when the construction of the pipeline is running parallel to a road.

At highway crossings and most major roads potential impacts are expected to include speed limitations, as these crossings will be bored. Trenching through road crossings may potentially result in delays due to temporary road closures or the use of a single lane with direction control being implemented.

The movement of the workforce between the ROW and accommodation facilities

To facilitate the pipeline construction, camps would be constructed at locations convenient to the ROW (refer to Section 5.5.2 for the criteria for locating construction camps). At any one time there would usually be one camp per spread.

Activities that would require vehicle movements between the ROW and accommodation facilities include:

- Workers moving between the camp and the ROW.
- Water cartage for dust management.
- Transport for waste disposal.
- Fuel deliveries.
- Floating equipment around major obstacles to the continuing ROW.

Table 11.12 outlines the approximate vehicle movement expected for each spread for the transportation from construction camps to the ROW.

Haulage of fuel for use at site would be by conventional road tankers through a licensed provider to the camp sites. Refueling of project vehicles would occur at the camp sites or be carried out by a dedicated tanker along the ROW. The fuel would be obtained via local wholesalers where economically feasible.

Transport of the crews at the start and end of the roster (ie 28 days on and nine days off) would typically be by coach to the nearest airport. The most practicable method in regards to commercial flights or charter aircraft would be considered for the transport of crews.

Local impacts relating to the movement of the workforce from camps to the ROW would include an increased number of vehicles on the local road networks. This may result in traffic levels that small rural communities are not accustomed to, in particular increased traffic within school zones, between the times of 8am–9.30am to 2.30–4pm.

11.5.3 Proposed mitigation and management measures

General traffic and transport impacts as a result of the proposal during construction would be manageable through the implementation of standard mitigation and management measures as outlined in Table 11.13.

Table 11.13 Traffic and transport management and mitigation measures during construction

Potential impacts	Mitigation and management measures
The mobilisation and demobilisation of construction plant, equipment and construction camps.	• Further consultation with residents and road authorities (ie Councils and the RTA) to outline pipe delivery timeframes and to identify localised impacts on traffic networks. • Any oversized or over weight loads would be transported in accordance with RTA requirements.
The transportation of pipe sections to the pipe storage facility.	• The pipe storage facilities would be located so that they are in close proximity to major transportation routes, including existing major highways and rail yards. • Further consultation with residents and road authorities (ie Councils and the RTA) to outline pipe delivery timeframes and to identify localised impacts on traffic networks. • Where oversized vehicles are used, suitable controls and management will be put in place and heavy vehicle permits would be obtained as required. • Any oversized loads would be transported in accordance with RTA guidelines. • Convoys of heavy vehicles would be avoided as far as practicable.
The transportation of pipe sections to the ROW.	• Pipe delivery to the ROW would be conducted in daylight hours. • Timing of transport movements to minimise localised impacts, such as avoiding peak times and school zones during the hours 7am–9am and 2pm–4pm.

Construction activity at or near a road.	• Preparation of crossing plans in consultation with the appropriate road authority (ie Councils or the RTA).
	• Horizontal boring would be undertaken at highway crossings.
	• Trenching through road crossings would use traffic direction control by either manual or mechanical means in conformity with road management guidelines.
	• Utilisation of a small, specialised, crew where open cut is required, limiting disruption to no more than one or two days.
	• Where traffic management is required on any roadway, all features of the management would be installed in compliance with the requirements of Australian Standard 1742.3, Part 3 – Traffic Control Devices for Works on Roads.
	• Road closures should generally only be implemented under the following conditions:
	  • The duration of the closure should be limited to less than one week.
	  • The road should not form the single route to or from a major settlement.
	  • The road should not be relied upon for necessary local services such as public transport or school bus routes.
	  • The length of the detour should be less than 4km.
	• Where a road closure is required all signage would be installed in accordance with AS1742.3 and the RTA Technical Direction TD 2006/05.

The movement of the workforce between the ROW and the accommodation facilities.	• The use of multi-passenger vehicles where practicable for transportation of construction crews to/from the ROW to minimise the number of vehicle movements. • The camp sites would be self-sufficient in relation to catering etc, thus limiting the need for workers to leave the site after hours. • The movement of the workforce will be timed to avoid school zones to minimise impacts relating to increased traffic activity.

11.6 Fieldwork

Fieldwork relates to the undertaking of additional work, prior to and/or during construction, to enable the development of the most appropriate mitigation and management measures suitable to the construction activities and programme of works and seasonal and site specific conditions closer to the time of actual construction. This is particularly relevant for those impacts on human amenity arising from changes in existing ambient levels for noise, air quality and traffic. It should be noted however that human amenity impacts during the construction period would be transient in nature (ie the impacts would not be specific to an area for the entire construction duration, as construction moves progressively).

11.6.1 Ongoing community consultation

An extensive consultation programme has been implemented (refer to Chapter 6) and would be continued during the construction phase of the project. Key elements in relation to the management of human amenity issues are:

- A contact management procedure.
- Construction notifications.

Contact management

Contact management procedures would be developed during construction planning and contained within the CEMP. The contact management procedure would include the following components:

- Establish a toll free 24-hour contact number.
- Implementation of a contact register.
- Contact form to document details such as:
  - Contact details.
  - Description of any concerns or issue.
  - Time/date of concern or issue.
  - Ambient conditions relating to the issue period.
  - Site activities being undertaken during the period of issue or concern.
  - Possible external causes.
  - Possible causes and corrective action taken.
  - Person responsible for implementing corrective action.
  - Action taken and closure.
- Time frame for responding to all concerns (eg initial response within 24 hours).
- Regular reviews of the contacts register to ensure all issues or concerns have been closed out and corrective actions implemented.

The corrective action may involve modification of construction techniques or programme to avoid any recurrence of the event or to minimise the adverse effects of an activity. This would also enable the identification of site-specific measures to minimise impacts relating to human amenity (noise, air and traffic).

Construction notifications

A programme of construction notification would be undertaken for residences identified in proximity to the ROW, pipe storage facilities and construction camps. Construction notifications would be used to advise residences of temporary changes in human amenity conditions relating to construction activities. The main impacts would be related to temporary changes in ambient noise levels and increased traffic levels.

The programme of notifications would consider a range of community consultation information methods, including letter dropping, phone calls, door knocking, community information sessions, newspaper notifications and information leaflet distribution. Notifications would include information on the extent, duration and type of impacts likely to be expected and contact information, including a 24-hour toll free contact number.

Locally affected residences requiring notifications would constitute:

- Isolated and sensitive receptors (such as residences, schools and hospitals) within a 350m distance of construction related activities.
- Populated places within a 250m distance of construction related activities.
- Residences adjacent to a pipe transportation access point along the ROW that would be impacted by an increase in traffic generation.

11.6.2 Noise

As the Study Area is refined, all potential receptors within the off-set distance identified for major noise impacts (350m for isolated receivers and 250m for township receivers) would be identified and notified. If required, based on consultation, location specific mitigation measures may be implemented to ensure noise level restrictions are met and that moderate and minor off-set distances may be employed should construction durations, near any single receiver, exceed four weeks.

11.6.3 Blasting

To ensure that blast overpressure levels are within acceptable limits and comply with the relevant criteria, the construction contractor would be required to monitor initial trial blasts to ascertain the overpressure impacts and attenuation characteristics of the ground around the blast zone. This information would be used to develop a suitable blast programme for the site. It is expected that provided a precautionary approach to initial blasts are used and the programme adjusted accordingly, compliance with the blast criteria would be achieved. A detailed assessment of blasting requirements would be undertaken as part of the detailed design.
As the pipeline ROW and blasting parameters and design are determined, blast emission levels would be confirmed and residences potentially within the complying distance (250m) for blasting parameters would be identified and notified. The development of specific mitigation measures would be undertaken for these receptors to ensure blasting parameter restrictions are met.

11.6.4 Traffic

A generic assessment of traffic has been provided and corresponding standard mitigation measures developed. However, fieldwork to both understand and mitigate traffic related impacts is considered below in relation to localised traffic impacts and road crossing impacts.

Traffic generation

Once transport routes, stockpile locations and camp site locations have been determined for the proposal, the impact of vehicle movements would be determined in order to establish appropriate site specific mitigation measures for the relevant local area. This would be documented in the CEMP. This localised fieldwork would include:

- A review of traffic related impacts would be undertaken in relation to existing local traffic volumes and road networks.
- A determination of potentially affected (traffic related) receivers.
- Consultation with residences, councils and the RTA to understand impacts and develop specific mitigation measures from a localised perspective.
- A series of construction notifications based on the understanding of construction programming and pipe delivery timeframes.

Traffic management at infrastructure crossings

The extent and type of traffic management treatments at each crossing will depend on a number of factors relating to the exiting background traffic volumes, the traffic activity associated with the works and the scale of the construction works taking place at each crossing point.

Whilst a generic crossing detail may be applicable in most instances, other site specific factors such as access to property and geography will also influence the construction process and therefore the traffic management treatment for the relevant local area.

Traffic management treatment is considered an ongoing process that would be defined prior to and during construction in a local area. Detailed design consideration and ongoing consultation with infrastructure owners/managers is discussed in Chapter 16.

12 Socio-economic impacts

12.1 Introduction

An overall indicative socio-economic assessment has been undertaken to gain an understanding of the social and economic impacts of the development and operation of the QHGP.

The economic impact of the Study Area has been assessed with reference to the employment opportunities (both direct and indirect) associated with the construction phase and the overall economic impact of the construction activities. The economic impact of the possible flow on activities (eg industrial, commercial and residential) has also been reviewed.

12.2 Socio-economic overview of the Study Area

For the purposes of the socio-economic assessment, the Study Area has been broken down into the ten local government areas through which the Study Area passes.

12.2.1 Moree Plains

Agricultural industries predominate in the Moree Plains Shire. Cotton is the major agricultural crop with the Shire home to several cotton gins. Other major agricultural products include beef cattle, pecan nuts, olives, wheat, wool and cereal crops.

The main areas of employment in the Moree Plains local government area are:

- Agriculture, forestry and fishing (26.9 per cent).
- Retail trade (9.8 per cent).
- Health care and social assistance (7.8 per cent).
- Construction (6.3 per cent).

12.2.2 Narrabri

The Narrabri area produces cotton, beef, wheat, fat lambs, wool, barley and a variety of other crops such as grapes and peanuts. The annual value of agricultural production is in excess of $330 million per year, including more than $200 million from cotton. These large agricultural industries are supported by a range of specialist supply, engineering, chemicals and consulting firms.

The Narrabri shire is home to open cut coal mining and the emerging Wilga Park coal seam methane operations. Coal mining operations are within the Gunnedah coal basin near the towns of Boggabri and Baan Baa.

The main areas of employment in the Narrabri local government area are:

- Agriculture, forestry and fishing (25.1 per cent).
- Retail trade (10.1 per cent).

- Health care and social assistance (7.8 per cent).
- Transport, postal and warehousing (6.7 per cent).

12.2.3 Gunnedah

Gunnedah Shire is located on the Sydney-Gunnedah Basin, one of the largest underground coal seams in NSW. Gunnedah has both open cut and underground coal mining operations at the Gunnedah Colliery to the west of the town.

Agriculture is the largest industry in the Shire, occupying an area of approximately 402,484 hectares, including nearly 117,302 hectares of cropping.

The Shire supports diverse agricultural activities including both winter and summer cropping, cattle, sheep and pigs. Wheat is the most widely grown crop in the Shire followed by sorghum, barley, maize and sunflowers. Cotton has also become a major crop with other important crops including oats, canola, soybeans, mung beans, chickpeas and safflower. Agriculture provides an income of around $120 million per year.

Other economic activities in the area include the Gunnedah Grains to Ethanol project, ongoing coal mining exploration in the Watermark area, brick and terracotta production, tannery and leather processing, timber milling, skilled metal manufacturing and farm machinery production.

The main areas of employment in the Gunnedah local government area are:

- Agriculture, forestry and fishing (18.2 per cent).
- Retail trade (10.3 per cent).
- Health care and social assistance (9.2 per cent).
- Manufacturing (9.0 per cent).

12.2.4 Liverpool Plains

Agriculture is the dominant activity in the Liverpool Plains Shire with 260,000 hectares producing crops such as sorghum, barley, sunflowers, maize, mung beans, soybeans, cotton, canola and chickpeas and livestock including cattle, sheep, poultry, pigs and goats.

The region is home to a boutique olive industry with more than 200,000 olive trees producing table fruit and oil.

Large areas of the Liverpool Plains are being investigated for exploration and possible future development of coal mines.

The main areas of employment in the Liverpool Plains local government area are:

- Agriculture, forestry and fishing (27.8 per cent).
- Health care and social assistance (8.9 per cent).
- Retail trade (8.5 per cent).
- Transport, postal and warehousing (7.5 per cent).

12.2.5 Upper Hunter

The Upper Hunter Shire is a rural community centred around agriculture, in particular the thoroughbred horse industry. The Shire is also a major cattle, pig, poultry, goat and grain producer and has increasing numbers of vineyards.

The main areas of employment in the Upper Hunter local government area are:

- Agriculture, forestry and fishing (20.3 per cent).
- Retail trade (9.6 per cent).
- Manufacturing (8.5 per cent).
- Health care and social assistance (7.7 per cent).

12.2.6 Muswellbrook

Coal mining is the main source of economic activity in the Muswellbrook local government area. It is also home to a large agricultural community with a strong viticulture industry. The region has a strong history of dairy cattle and lucerne production and is also home to 18 horse studs.

Besides mining and agriculture Muswellbrook has a large industrial estate serving the mining industry and a strong retail base.

The main areas of employment in the Muswellbrook local government area are:

- Mining (16.3 per cent).
- Retail trade (10.1 per cent).
- Agriculture, forestry and fishing (9.1 per cent).
- Manufacturing (7.1 per cent).

12.2.7 Singleton

The Singleton local government area has a diverse industrial and agricultural profile including coal mining, power generation, defence training, beef cattle, dairy, wine production and tourism.

Coal mining is the main economic activity in the area with 21 coal mining operations in the Upper Hunter. Singleton is also the base for many of the coal mining industry support operations.

The main areas of employment in the Singleton local government area are:

- Mining (19.9 per cent).
- Retail trade (9.8 per cent).
- Manufacturing (7.4 per cent).
- Accommodation and food services (6.5 per cent).

12.2.8 Maitland

The Maitland local government area is concentrated around the Maitland town centre and, as such, agriculture and mining are not the major sources of employment. However, these industries are supported through a strong retail, health and manufacturing presence.

Maitland has been a significant area for exploration of mineral resources including coal, sand, gravel, rock and clay. Coal mining in the local government area has declined over the past 20 years with the closure of mining works in East Maitland and cessation of mining along the Great Coal Measures.

Agricultural land makes up about 17,400 hectares or 45 per cent of the local government area and main produce includes beef and dairy cattle, viticulture, olives, lucerne and poultry.

The main areas of employment in the Maitland local government area are:

- Retail trade (12.9 per cent).
- Manufacturing (12.6 per cent).
- Health care and social assistance (10.6 per cent).
- Construction (7.7 per cent).

12.2.9 Port Stephens

Port Stephens is a well-known tourist destination and most local industries are responsive to the tourism market. The main local agricultural product is oysters, with the industry worth around $2.4 million per year.

The main areas of employment in the Port Stephens local government area are:

- Retail trade (12.7 per cent).
- Manufacturing (10.6 per cent).
- Public administration and safety (10.5 per cent).
- Health care and social assistance (10.2 per cent).

12.2.10 Newcastle

The City of Newcastle is the economic hub of the Hunter Region and accounts for around 30 per cent of the Hunter's developed industrial space. The Port of Newcastle, the economic and trade hub of the Hunter Valley, is Australia's oldest and one of the largest tonnage throughput ports, with coal accounting for over nine per cent of cargo. Other bulk exports through the port include grains, vegetable oils, alumina, fertiliser and ore concentrates.

Newcastle has a large industrial base, mainly port-related, supported by a range of light and service industries as well as academic, technical and medical institutions.

The main areas of employment in the Newcastle local government area are:

- Health care and social assistance (15.0 per cent).
- Retail trade (11.4 per cent).
- Manufacturing (9.8 per cent).
- Education and training (9.2 per cent).

12.3 Demographics

The key demographics of the ten local government areas are shown in Table 12.1. Initial discussions with local councils have indicated that low unemployment (between 4.2 per cent and 8.3 per cent – refer to Table 12.1) and a shortage of skilled workers are typical of the region due to the large number of skilled workers required by the mining industry.

Aboriginal stakeholders have indicated a strong interest in seeking employment on the pipeline proposal (refer to Chapter 6). Each of the affected local government areas has large Aboriginal populations compared with the NSW average. In particular, the Moree Plains Shire with 19.4 per cent and Gunnedah Shire with 10.2 per cent have comparatively high Aboriginal populations (refer to Table 12.1).

Table 12.1 Demographics of local government areas through which the Study Area passes*

Local government area	Estimated residential population	Area (km^2)	Population density ($people/km^2$)	Aboriginal and Torres Straight Islander Population (per cent)	Median age of persons	Median individual income ($/week)	Unemployment rate (per cent)
Gunnedah	11,524	4,993.9	2.3	10.2 per cent	40	$366	8.3 per cent
Liverpool Plains	7,541	5,085.8	1.5	9.5 per cent	43	$351	5.9 per cent
Maitland	61,881	391.7	158.0	2.6 per cent	35	$428	6.5 per cent
Moree Plains	13,975	17,927.7	0.8	19.4 per cent	34	$471	6.3
Muswellbrook	15,237	3,405.6	4.5	4.8 per cent	34	$453	5.4 per cent
Narrabri	13,117	13,030.6	1.0	9.2 per cent	37	$410	7.1 per cent
Newcastle	141,752	214.5	660.1	2.1 per cent	37	$409	7.3 per cent
Port Stephens	60,485	979.5	61.8	2.9 per cent	40	$388	7.1 per cent
Singleton	21,939	4,895.8	4.5	2.6 per cent	34	$487	4.2 per cent
Upper Hunter	12,975	8070.7	1.6	3.1 per cent	39	$438	4.5 per cent
State of NSW	**6,549,177**			**2.1 per cent**	**37**	**$461**	**5.9 per cent**
Australia	**19,855,288**			**2.3 per cent**	**37**	**$466**	**5.2 per cent**

** Source: Australian Bureau of Statistics 2006 Census of Population and Housing*

Part B

12.4 Potential impacts

12.4.1 Construction

The construction phase of the proposal is expected to have the greatest level of social impact on local communities. The pipeline construction would pass through mainly regional areas that have a low population density. In the southern, more densely populated regions such as Newcastle, Maitland and Port Stephens pipeline construction activities are more likely to affect a greater number of people than in other areas. However the high level of industrial activity in these more densely populated areas suggests that short duration construction impacts would be more easily assimilated than in rural areas.

The majority of these impacts, such as increased traffic, noise and safety, are short-term, directly associated with the physical construction processes and are addressed in other chapters:

- Traffic and transport impacts that may arise during the construction phase are addressed in Section 11.5.
- Noise and vibration impacts that may arise during the construction phase are addressed in Section 11.3.
- Hazards and risks that may arise during the construction phase are addressed in Chapter 14.
- Impacts on air quality that may arise during the construction phase are addressed in Section 11.4.

Other social impacts may arise from the presence of a large number of pipeline employees working and residing in construction camps. The construction phase of the proposal is not anticipated to have any long-term impact on demographic change, increased development demand or local employment. There would be a short-term positive impact on local employment, although this would be minor. There would be a short-term impact on social infrastructure and services, namely medical and emergency services, however this impact would be limited to the presence of the construction workforce.

Economic impacts during construction would vary depending on local circumstances. However, in terms of the proposal as a whole, local communities would benefit from the presence of the construction workforce due to increased demand for goods and services such as food and fuel supply and equipment hire.

Landholders directly impacted by construction would benefit from compensation for the creation of the easement on private lands.

Other potential impacts from construction of the QHGP are summarised below.

Privacy and access for individual landowners

Individual landowners impacted by construction activities are generally located in rural areas where there is low population density and little impact from neighbours and surrounding communities.

Properties through which the pipeline construction passes would be subject to construction activities that may restrict access to parts of the property for short periods of time. This could include storage of plant and equipment on site.

In addition there may be some loss of privacy during construction due to the presence of pipeline construction workers on private property.

Compensation and easement acquisition

There are around 661 individual landowners within the Study Area who between them own over 2214 parcels of land. It is anticipated that, once the final pipeline ROW has been established around 846 parcels of land would be directly impacted by the pipeline crossing their property.

The properties that are directly affected by the pipeline ROW would be subject to an easement across the property to allow for the construction and ongoing maintenance of the pipeline. Section 5.6 explains the implications of the creation of a pipeline easement.

Where access agreements are not reached then the proponent may need to attain access to those parcels of land through a compulsory acquisition process to be undertaken in accordance with the *Just Terms Compensation Act*. Any decision to compulsorily acquire an easement would be a decision of government, not the proponent.

Employment

Local communities around the Study Area are currently employed in a range of industries, such as mining, manufacturing and construction, where skilled tradespeople are in high demand. Section 12.3 provides an overview of unemployment levels in each local government area.

Around 600 jobs would be created during the construction period. Most of these roles will be for pipeline specialists who would work along the length of the pipeline for the duration of its construction.

The majority of these workers would be required to have specialist skills, such as high-pressure pipeline welding, due to the specific nature of gas transmission line construction. It is likely that appropriately skilled local workers would be in long-term employment with local industries, such as mines, and would not be likely to take up short-term pipeline employment. Therefore most of these workers would be sourced from outside the local community.

There would be some opportunities for local and indigenous labour to work on certain aspects of the pipeline construction, for example clearing and grading of land.

Local economic activity

The pipeline proposal has the potential to generate significant local economic activity during the construction period through the procurement of equipment and services related to the pipeline construction, supply of food, fuel and other supplies to support the workers and the proposal, and use of local facilities and infrastructure.

Due to the size of the construction workforce and limited availability of rental accommodation in rural areas the construction workforce would be housed in self-sufficient construction camps. Food and other supplies would be mostly sourced from local towns and suppliers, generating short-term economic activity. The presence of a large number of construction personnel could place a strain on local resources such as emergency services and recreational facilities, although this impact would be temporary.

Access to temporary local facilities and infrastructure would be required during the construction phase. Examples could include work areas for equipment and pipe delivery and materials storage, and locations for construction camp sites. The exact number and location of such facilities are not yet known and would form part of the detailed design phase of the proposal.

Access to rail lines for transport of pipes and other materials may also be required. All of these activities would contribute positively to local economic activity.

12.4.2 Operation

Employment opportunities during operation

It is estimated that around 25 permanent jobs would be created in the areas of operation and maintenance. These jobs would include activities such as conducting regular inspections of the pipeline easement either by ground vehicles or by aircraft and carrying out repairs.

Future land use

Following the construction of the pipeline, the easement would be returned as closely as possible to its previous condition and productivity to minimise adverse economic impacts on landowners. Certain types of land use (eg digging ponds or farm dams, installation of permanent structures, growing of trees) would not be possible over the pipeline following construction due to the risk of compromising the safety of the pipeline.

General agricultural activities, such as cropping and grazing, are compatible with pipeline operations and are encouraged on the easement following reinstatement.

The potential impact of the pipeline on future land use is addressed in Chapter 13.

Hazards and risks

Hazards and risks associated with ongoing operation of the pipeline are addressed in Chapter 14.

Capital investment

The construction of the NSW portion of the pipeline from the Queensland/NSW border to Kooragang Island is expected to bring a direct capital investment of around $600 million.

Additional indirect benefits estimated by ANZIS (QHGP proposal benefits, ANZ Infrastructure Services – see Volume C, References) could include:

- Expansion of aluminium smelters in the Hunter Region – around $1,080 million.
- Development of an 800MW gas fired power station – around $680 million.
- Development of coal seam gas exploration and production in north east NSW – around $100–200 million.

Local and regional economic development

The pipeline would deliver a new source of gas in areas where it has not previously been available and increase security of supply for existing commercial, industrial and domestic users.

Many local industries along the Study Area are current or potential future users of gas, for example cotton gins, feedlots and ethanol producers. The introduction of a secure and more competitively priced supply of gas to these areas would assist in expanding existing industrial centres and encourage industries reliant on gas to set up new projects in the region.

The Lower Hunter Regional Strategy has identified that the region is expected to have population growth of up to 160,000 new residents and around 66,000 new jobs over the next 25 years with a significant proportion of these jobs to be provided within traditional industries including electricity generation, manufacturing and aluminium smelting.

Investment in expansion of these industries would be influenced by the availability of infrastructure and cost effective and secure energy supplies.

Most of the local councils along the Study Area have expressed an interest in accessing gas for use in their local area, both for industrial and domestic use. The economic feasibility of creating take-off points in major regional centres along the pipeline route requires further investigations with potential retailers and customers.

The development of the pipeline proposal would facilitate further developments in regional industries through:

- Accelerating development of existing industrial zones such as the Hunter Economic Zone and the Macquarie Buffer Zone.
- Retention and attraction of energy-intensive industries.

This document does not attempt to quantify the investment value of such regional developments including the broader secondary economic effects that these investments could have on the regional and NSW economies. However ANZIS (QHGP proposal benefits, ANZ Infrastructure Services – see Volume C, References) has estimated that these secondary benefits could have economic multiplier effects of around three times in the urban areas and seven times in regional areas.

Economic benefits to NSW

The economic benefits to NSW from the development of gas exploration and production in the region include:

- Increased gas supply security through diversification.
- Royalty revenue from exploration and production for the State – around $15 million over ten years.
- Promotion of industrial and regional development.
- Driving greater market competition through the supply of competitively priced gas.
- Employment creation.

NSW is the largest energy market in Australia. However, almost all gas is currently imported from interstate. The distance the gas travels to reach NSW markets requires high tariffs to be paid by end users. By closing the loop in the Australian gas transmission network, the QHGP would not only provide an additional supply of gas to the region, but could ensure that lower tariffs are paid by end users due to the smaller distance travelled by the gas.

NSW has the resources and potential to become a source and supplier of gas for the east coast markets through the development of coal seam gas reserves in the state's north. The potential for domestic, commercial and industrial connection to gas supplies in major centres in future is addressed in Chapter 2.

Local and regional social impacts

The pipeline is unlikely to lead to demographic change or increased need for social infrastructure and services in the mid-to-long term in major centres.

12.5 Proposed mitigation and management measures

12.5.1 Construction

The following table outlines proposed mitigation and management measures to address potential impacts arising during construction and from construction related activities associated with the QHGP.

Table 12.2 Socio-economic mitigation and management measures during construction

Potential impact	Mitigation and management measures
Privacy and access issues	• Final ROW selection across private properties would be agreed, as far as practicable, in consultation with landowners to minimise adverse impacts to property owners. • The location for storage of plant and equipment, and access hours and conditions would be negotiated with individual landowners to minimise access restrictions and impacts on privacy.
Creation of easement	The proponent is actively negotiating with landowners along the Study Area in relation to the location of easements, above ground infrastructure and compensation. Negotiations would continue on issues relating to compensation and terms and conditions of consent agreements.
Local employment opportunities	Strategies would be put in place to maximise employment opportunities for local and indigenous workers. These strategies may include working with local Aboriginal employment and training agencies and Aboriginal communities to identify opportunities, working with local chambers of commerce and advertising in local papers.

12.5.2 Operation

Proposed mitigation and management measures relating to potential socio-economic operational impacts are addressed in:

- Chapter 13 for potential impacts of the pipeline on future land use.
- Chapter 14 for hazards and risks associated with the ongoing operation of the pipeline.

Other impacts from the operation of the proposed QHGP are expected to deliver economic benefits by allowing potential opportunities relating to capital investment, local and regional economic development and NSW gas exploration.

13 Land use

This section addresses planning and land use with particular emphasis on potential constraints created by the proposal. Potential human amenity impacts of the proposal are addressed in detail in Chapter 11. However, consideration is given to potential human amenity impacts in this chapter as they relate to land uses along the Study Area. Consideration is also given to the potential for the proposal to negatively impact on agricultural production due to the significance of agricultural and rural lands along the Study Area.

Mitigation of potential land use impacts is inherent in the design and safety features of the proposed pipeline and through the development of the pipeline route. The selection of the Study Area has been determined on a number of factors, principle to which has been the avoidance of current and future land use conflicts.

Specifically, the Study Area has been selected to minimise impacts on the natural and built environment and local communities. Issues that have been considered in determining the Study Area include:

- Addressing topography and geology along the Study Area.
- Existing and future land use.
- Minimising impact on flora and fauna, in particular endangered ecological communities.
- Avoiding urban areas.
- Minimising the number of affected landholders.
- Minimising the impact on Aboriginal and historical heritage.
- Minimising impacts on agriculture, including minimising the spread of weeds and other material between work areas.
- Minimising impacts on extractive industries.
- Minimising the number of creek and river crossings.
- Minimising the number of road and railway crossings.
- Avoiding interference with existing utilities.
- Minimising impacts on environmentally sensitive lands including TSRs.

The proposal is generally consistent with, and permissible under, the existing statutory land use framework along the Study Area. The design, construction methodology, and the Study Area have been developed to limit and mitigate, as far as practicable, against any potential impacts that may arise during the construction and operation phases.

Where potential land use conflicts that cannot be avoided through the development of the pipeline route or inherent design have been identified in the assessment, appropriate mitigation measures have been proposed to limit those impacts. These impacts are principally around the loss of agricultural production associated with the construction of the proposed pipeline and the ongoing operation of aboveground infrastructure. Where this conflict occurs, the proponent intends to ensure that terms and conditions of access and compensation would be negotiated with relevant landholders.

Further detail on the methodology used to select the preferred Study Area is outlined in Chapter 3.

13.1 Assessment of land use impacts

The methodology used to complete the assessment of potential land use impacts included:

- A review of local planning context including statutory land use planning controls and settlement strategies for each LGA through which the Study Area passes.
- A review of prominent agricultural uses and activities within each LGA through which the Study Area passes.
- Identification and review of potential land use conflicts and impacts with particular emphasis on urban and agricultural land uses and extractive industries. The assessment of potential risks associated with the proposal (refer to Chapter 14) includes an evaluation of both short and long-term impacts associated with the ongoing operation of the pipeline.
- Identification of mitigation measures to ameliorate potential land use impacts of the proposal during construction and operational phases such as construction phasing and provision of buffers where possible between existing activities and the ROW.

13.1.1 Agricultural land uses

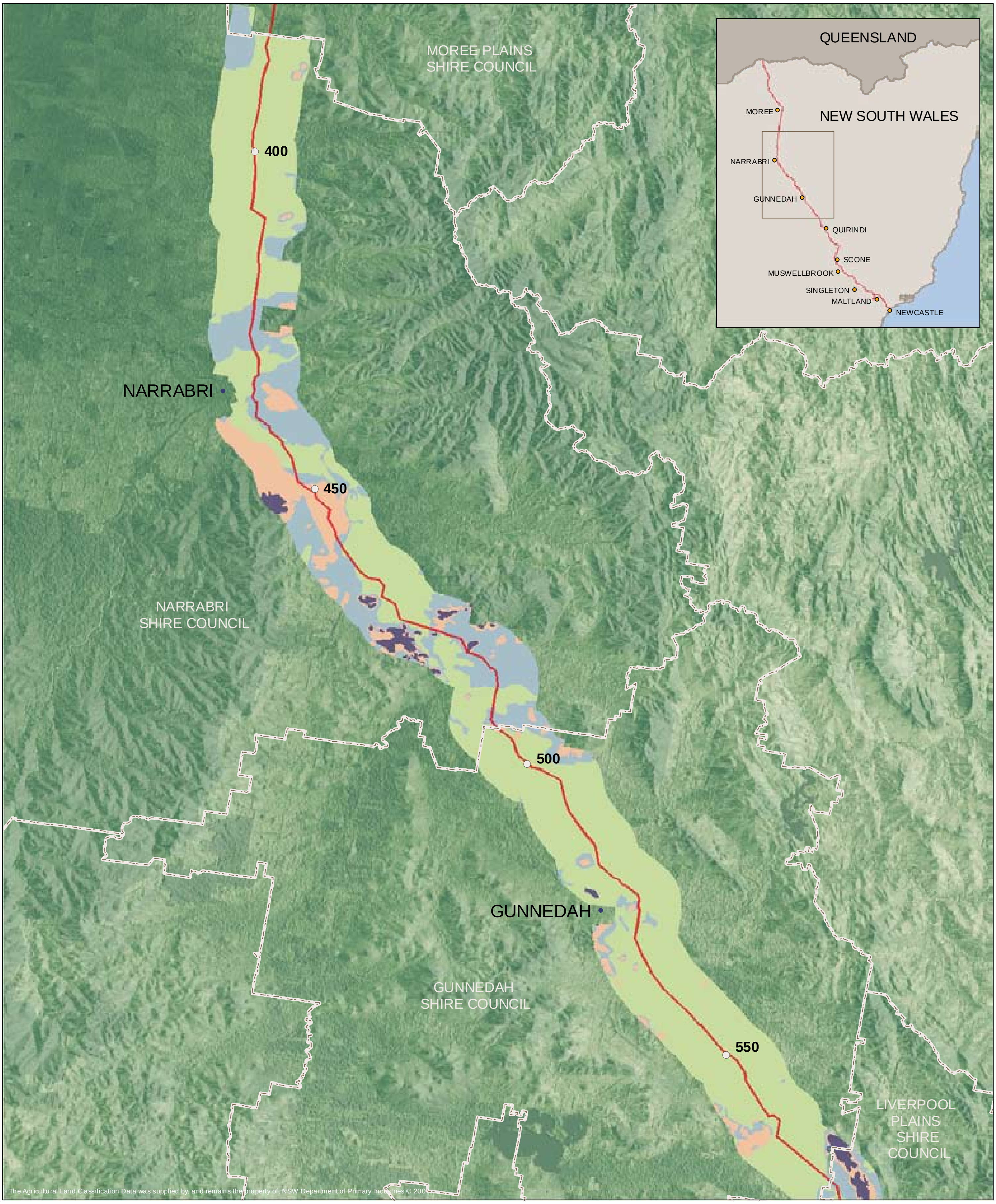
Due to the significance and extent of agricultural land within the Study Area, specific consideration has been given to assessing the potential impact of the QHGP, both during construction and operation on agricultural production. Specific attention has also been given to developing a range of mitigation measures to address potential impacts on agricultural production.

As described in Section 6.3.4, there has been and will continue to be detailed consultation with landholders to understand any potential impacts on their agricultural production and endeavour to negotiate terms and conditions relating to construction activities on their land which may include, access, weed management, crop control in relation to GMO, livestock security and any site specific management and mitigation measures. Post construction, the pipeline easement would be suitable for cropping and grazing but not suitable for activities which might breach the integrity of the pipeline or limit access such as long term plantings due to roots (eg trees or orchards), construction of farm buildings, wiring for vineyards or fence postings. Consultation on these issues would be undertaken with DPI during all phases of the project.

The agricultural land evaluation methodology used by the DPI classifies rural land into five classes according to its suitability for a wide range of agricultural activities being:

- Class 1 – Arable land suitable for intensive cropping.
- Class 2 – Arable land suitable for regular, but not continuous, cropping.
- Class 3 – Grazing land or land well suited to pasture improvement.
- Class 4 – Land suitable for grazing, but not for cultivation.
- Class 5 – Land generally unsuitable for agriculture or at best suitable for occasional light grazing or supporting activities.

An outline of the classification of agricultural land along the Study Area is presented in Figures 13.1 and 13.2. DPI data was not available for areas in Moree Plains Shire or south of Maitland.



Drawing no. 07002g_CP_LU_01-1

Date 02 September 2008

Source NSW Dept Primary Industries RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- LGA boundary

DPI Agricultural land classification

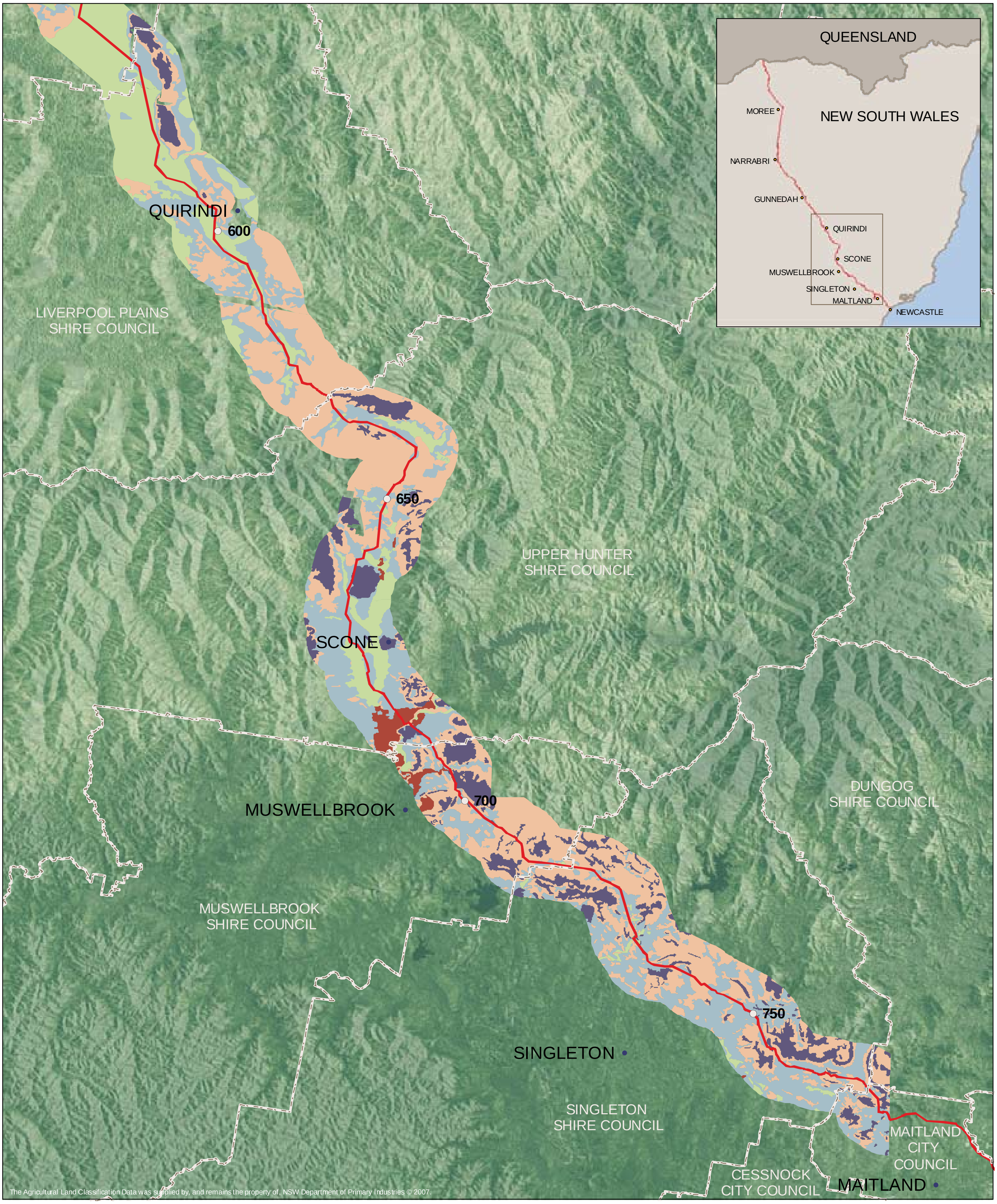
- Class 1: Arable land suitable for intensive cropping
- Class 2: Arable land
- Class 3: Grazing land
- Class 4: Grazing land not suited to cultivation
- Class 5: Occaisional light grazing only

Queensland Hunter Gas Pipeline

1:700,000 (at A4)

0 5 10 15 20km

Figure 13.1 Agricultural land classification within 10km: central region



Drawing no. 07002g_CP_LU_02-1

Date 02 September 2008

Source NSW Dept Primary Industries
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- LGA boundary

DPI Agricultural land classification
- Class 1: Arable land suitable for intensive cropping
- Class 2: Arable land
- Class 3: Grazing land
- Class 4: Grazing land not suited to cultivation
- Class 5: Occaisional light grazing only

Queensland Hunter Gas Pipeline

Figure 13.2 Agricultural land classification within 10km: southern region

1:700,000 (at A4)

0 5 10 15 20km

13.1.2 Extractive Industries and Resources

The Study Area has been selected to avoid existing mining and quarrying activities. The pipeline provides a valuable resource in its own right as well as a complementary resource in that proximity to the pipeline may facilitate the exploration and development of other potential resources in the vicinity. As described in Chapter 3, route selection criteria involved balancing a number of factors, including avoiding difficult terrain, environmentally sensitive areas (eg TSRs), sensitive agricultural use and reducing the number of water crossings and affected landholders. To the limited extent that the Study Area crosses areas of future potential resource, the impacts are not considered to be significant as these are areas which are unlikely to be explored or mined due to the existence of nearby sensitive uses. Further, if at some point in the future, exploration or development is sought to be expanded to areas under the pipeline, then the pipeline could be moved at the cost of the miner. Consultation with DPI and the Mines Subsidence Board will be undertaken during all phases of the project.

13.1.3 Identification of land use impacts

The screened assessment has identified key land use constraints along the Study Area. These constraints are classified as:

- Significant impact – where the proposed pipeline would be likely to have a significant impact during either the construction or operational phases.
- General impact – land use on which the proposal is likely to have a general impact during either the construction or operational phases.

Table 13.1 outlines the description of potential land use impacts screened as part of this assessment.

Table 13.1 Land use impact classifications

Impact classification	Description
Significant impact	• Existing residential settlements and associated infrastructure. • Areas identified for future urban expansion. • Employment lands. • Regional infrastructure including port related activities at Newcastle. • Extractive industries and identified resources. • Class one agricultural lands. • Environmentally sensitive lands.
General impact	• Rural residential lots. • General agricultural production.

13.2 Moree Plains Shire

13.2.1 Local government area description

The Shire of Moree Plains is located in the fertile Gwydir Valley and McIntyre River Valley, in the north west of the state. This Shire is characterised by rural townships whose economies are based on traditional agricultural industries, including cotton, grains, nuts, oilseeds and sheep and cattle grazing. The town of Moree is the most significant settlement within the Shire.

13.2.2 Statutory plans and zoning

The *Moree Plains Shire Local Environmental Plan 1995* applies to land within this section of the Study Area.

The Study Area passes through land zoned 1 (a) (General Rural). The objective is to promote the proper management and utilisation of resources by protecting agricultural land for efficient and effective agricultural production. Utility undertakings are permissible with consent under the 1 (a) (General Rural) zone.

13.2.3 Land use impact assessment

Table 13.2 shows the land use impact assessment for the Moree Plains LGA.

Table 13.2 Land use impact assessment – Moree Plains

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing or proposed urban settlements	• Nil impact on the villages of Boomi, Garah and Ashley.	• The Study Area has been selected to pass the villages of Boomi, Garah and Ashley at a significant distance to mitigate any potential impacts.
	• Nil impact on the town of Moree.	• The Study Area has been selected to pass around 5km to the east of Moree so as to mitigate any current impacts or those that may present through future urban expansion.
Existing major infrastructure	• The Study Area makes a number of crossings of the Carnarvon Highway and the Moree Weemelah Railway to the south of Garah and the north of Ashley. • The Study Area crosses the Newell Highway and the Moree Weemelah Railway to the south of Ashley. • The Study Area crosses the Gwydir Highway to the east of Moree.	• Chapter 16 of the EA details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.
General impact		
Existing or proposed rural residential lots	• The Study Area runs to the west of a number of smaller agricultural lots located at the confluence of the Gwydir Highway and the Moree Terry Hie Hie Road.	• Chapter 11 of the EA outlines measures to be implemented during construction and operation of the pipeline to mitigate potential impacts such as noise, dust and vibration. • The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given.

Impact classification	Identified impact	Mitigation measures

General agricultural uses	• The Study Area runs through and contiguous to general agricultural activities. Potential impacts include:
	  • Temporary loss of productive capacity during construction.
	  • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.
		• Consultation with landholders would be taken into account in ROW refinement.
		• Terms and conditions of access and compensation would be negotiated with landholders.
		• Endeavour to negotiate terms and conditions relating to construction activities on agricultural land.
		• Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity.
		• Advance notification of potentially disruptive activities would be given.
		• The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.3 Narrabri Shire

13.3.1 Local government area description

Narrabri Shire is in the heart of the rich Namoi Valley and is renowned for the production of some of the world's highest quality wheat, cotton, fat lambs and beef**.** Over 50 per cent of the land within the Shire is dedicated to agricultural production.

A number of open cut coal mines are located near the towns of Boggabri and Baan Baa. The principal administrative and commercial centre of the Shire is the town of Narrabri.

13.3.2 Statutory plans and zoning

The *Narrabri Local Environmental Plan 1992* applies to the land within this section of the Study Area.

The Study Area passes through land zoned 1 (a) (General Rural). The objective is to promote the proper management and utilisation of resources by protecting agricultural land for efficient and effective agricultural production. Utility undertakings are permissible with consent under the 1 (a) (General Rural) zone.

13.3.3 Land use impact assessment

Table 13.3 shows the land use impact assessment for Narrabri LGA.

Table 13.3 Land use impact assessment – Narrabri

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing or proposed urban settlements	• Nil impact on Narrabri.	• The Study Area has been selected to pass around 3km to the east of Narrabri so as to mitigate any current impacts or those that may present through future urban expansion.
	• Nil impact on the villages of Bellata, Edgeroi, Turrawan, Baan Baa and Boggabri.	• The Study Area has been selected to pass to the east of Bellatta, Edgeroi, Turrawan, Baan Baa and Boggabri so as to mitigate any potential impact on the urban area.
Existing major infrastructure	• The Study Area crosses the Kamilaroi Highway to the north of Turrawan and to the north of Boggabri.	• Chapter 16 of the EA details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.
Extractive industries	• The Narrabri coal project site proposed by Whitehaven Coal Pty Ltd is located to the west of the Kamilaroi Highway to the north of Baan Baa.	• The Study Area has been selected to pass the proposed Narrabri coal project site to the east of the Kamilaroi Highway.
	• A number of existing and proposed open cut and underground coal mines are located to the east of Baan Baa. They include: • Maules Creek • Boggabri • Tarrawonga • Whitehaven.	• The Study Area has been selected to pass to the west of existing and proposed coal mining operations and is not expected to pose any material impact to these operations.
Environmentally sensitive lands	• Nil impact on the Bobbiwaa, Killarney and Leard State Forests.	• The Study Area has been selected to pass to the west of both the Bobbiwaa and Killarney State Forests.
General impact		
General agricultural uses	• The Study Area runs through and contiguous to general agricultural activities. The region is known for 'prime hard' wheat, summer crops, cotton and grazing. Potential impacts include: • Temporary loss of productive capacity during construction. • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated with landholders. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.4 Gunnedah Shire

13.4.1 Local government area description

Gunnedah Shire is located in the upper Namoi Valley within the Sydney to Gunnedah Basin and is a diverse agricultural area supporting both winter and summer cropping, cattle, sheep and pigs. Wheat is the most widely grown crop followed by sorghum, barley, maize and sunflowers. Cotton has become a major crop with some of the best quality cotton in the world produced in the Gunnedah area. Other important crops include oats, canola, soybeans, mung beans, chickpeas and safflower.

The Sydney to Gunnedah Basin is one of the largest underground coal seams in NSW. The town of Gunnedah is the principle administrative and commercial centre of the Shire.

13.4.2 Statutory plans and zoning

The *Gunnedah Local Environmental Plan 1998* applies to the land within this section of the Study Area.

The Study Area passes through land zoned 1 (a) (Agricultural Protection). The objectives of this zone are:

- To protect the use and efficiency of prime agricultural land while permitting appropriate development subject to suitable subdivision controls.
- To permit other forms of development, which are ancillary to rural land uses or that, as a result of their nature, require siting outside the urban area.
- To avoid further fragmentation and alienation of useable rural land.

Utility undertakings are permissible without consent under the 1 (a) (Agricultural Protection) zone.

13.4.3 Land use impact assessment

Table 13.4 shows the land use impact assessment for Gunnedah LGA.

Table 13.4 Land use impact assessment – Gunnedah

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing or proposed urban settlements	• Nil impact on Gunnedah.	• The Study Area has been selected to pass approximately 4km to the east of Gunnedah so as to mitigate any current impacts or those that may present through future urban expansion.
	• Nil impact on the towns of Curlewis and Breeza	• The Study Area passes to the east of Curlewis and Breeza ensuring no impact on these settlements.
Existing major infrastructure	• The Study Area crosses the Oxley Highway to the east of Gunnedah. • The Study Area crosses the Moree railway line to the south of Breeza.	• Chapter 16 of the EA details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.

Part B

Impact classification	Identified impact	Mitigation measures
Extractive industries	• The Belmont open cut coal mine and the Vickery mine site are located approximately 28km north of Gunnedah on the Wean Road.	• The Study Area has been selected to avoid the Belmont open cut mine and the Vickery mine site.
	• The proposed Sunnyside coal mine and the Gunnedah and former Preston mines are located to the west and south west of Gunnedah.	• The Study Area passes to the east of Gunnedah a significant distance from the proposed and existing mines.
General impact		
General agricultural uses	• The Study Area runs through and contiguous to general agricultural activities. The region is known for winter and summer cropping, cotton and grazing. Potential impacts include: • Temporary loss of productive capacity during construction. • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated with landholders. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.5 Liverpool Plains Shire

13.5.1 Local government area description

Liverpool Plains Shire is known as the ‘gateway to the north west' with the largest settlement in the Shire being the town of Quirindi. The Liverpool Plains are renowned as a significant agricultural region with approximately 260,000 hectares producing crops such as sorghum, barley, sunflowers, maize, mung beans, soybeans, cotton, canola and chickpeas and livestock including cattle, sheep, poultry, pigs and goats. The region is home to a significant olive industry.

Large areas of the Liverpool Plains are being investigated for exploration and possible future development of coal mining.

13.5.2 Statutory plans and zoning

Liverpool Plains Shire Council was formed in 2004 from an amalgamation of parts of Quirindi, Parry, Murrurundi and Gunnedah LGAs.

The *Quirindi Local Environmental Plan 1991* applies to part of the Study Area through Liverpool Plains Shire.

The Study Area passes through land zoned 1 (a) (Rural 'A' Zone). The objectives of this zone are to encourage the productive and efficient use of land for agricultural purposes and prevent inappropriate development of prime crop and pasture land for purposes other than agriculture. Utility undertakings are permissible within land zoned 1 (a) with development consent.

The *Murrurundi Local Environmental Plan 1993* applies to part of the Study Area through Liverpool Plains Shire.

The Study Area passes through land zoned 1 (a) Rural 'A' Zone. The objectives of this zone are to encourage the productive and efficient use of land for agricultural purposes. Utility undertakings are permissible within land zoned 1 (a) with development consent.

13.5.3 Land use impact assessment

Table 13.5 shows the land use impact assessment for Liverpool Plains LGA.

Table 13.5 Land use impact assessment – Liverpool Plains

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing or proposed urban settlements	• Nil impact on Quirindi and Old Warrah.	• The Study Area has been selected to pass to the west of Quirindi and to the east of Old Warrah so as to mitigate any potential impacts.
	• Limited impact on Willow Tree. Potential impacts include: • Dust and noise during construction. • Easement to limit potential for town expansion to the west of the railway line.	• The Study Area has been selected to pass to the west of Recreation Road and the Merriwa Murrurundi Road in Willow Tree. This alignment was chosen to avoid the principal settlement area to the east of the railway line along with rural residential lots to the east of Hall Road. • Chapter 11 of the EA outlines mitigation measures to be employed during construction and operation to avoid impacts on residences surrounding the ROW.
Existing major infrastructure	• The Study Area crosses the Binnaway railway line to the south of Breeza. • The Study Area crosses the Kamilaroi Highway to the north of Quirindi.	• Chapter 16 of the EA details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.
Extractive industries	• The Werris Creek open cut mine is located 4km south of Werris Creek on the Quirindi road.	• The Study Area has been selected to avoid the Werris Creek open cut mine.
	• The Ardglen Quarry is located approximately 4.5km to the north of Murrurundi.	• Detailed alignment of the ROW would be further investigated to avoid conflicts with the proposed future expansion of the quarry.

Part B

Impact classification	Identified impact	Mitigation measures
General impact		
General agricultural uses	• The Study Area runs through and contiguous to general agricultural activities. The region is known for winter and summer cropping, cotton and grazing. Impacts include: • Temporary loss of productive capacity during construction. • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated with landholders. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.6 Upper Hunter Shire

13.6.1 Local government area description

The Upper Hunter Shire is located at the northern end of the Hunter Valley. The Shire is known for cattle, crop, goat, pig, poultry and sheep production and has an increasing number of vineyards. The area is also known for significant horse studs particularly around Scone, which is the significant commercial centre in the region.

13.6.2 Statutory plans and zoning

Upper Hunter Shire was formed from the amalgamation of Merriwa, Murrurundi, and Scone Shires during 2004.

The *Scone Local Environmental Plan 1986* applies to part of the Study Area through Upper Hunter Shire.

The Study Area passes land zoned 1 (e) (General Agricultural Zone). The objectives of this zone are:

- To preserve the essential broad acre agricultural landscape by encouraging continued extensive agricultural land use and by discouraging land uses that may detract from that character.
- To protect and conserve large agricultural holdings and to encourage continuing and sustainable agricultural land use.
- To encourage only development which is ecologically sustainable and carried out in a manner that will not have any adverse impacts on the environmental qualities of the locality, particularly any adverse cumulative impact.

Utility undertakings are permissible with development consent under the 1 (e) (General Agriculture Zone). The *Murrurundi Local Environmental Plan 1993* applies to part of the Study Area through Upper Hunter Shire. The Study Area passes through land zoned 1 (a) Rural 'A' Zone. The objectives of this zone are to encourage the productive and efficient use of land for agricultural purposes. Utility undertakings are permissible within land zoned 1 (a) with development consent.

13.6.3 Land use impact assessment

Table 13.6 shows the land use impact assessment for the Upper Hunter LGA.

Table 13.6 Land use impact assessment – Upper Hunter

Impact classification	Identified impact	Mitigation measures
Significant impact		

Existing or proposed urban settlements	• Limited impact on Murrurundi. Potential impacts include:
	  • Dust and noise during construction.
	  • Easement to limit potential for town expansion to the west of the railway line.
		• The Study Area has been selected to pass to the south and west of the Murrurundi settlement boundary identified by Hill Street and Halls and Reservoir Roads.
		• Chapter 11 outlines mitigation measures to be employed during construction to avoid impact on residences surrounding the ROW.
		• The Study Area also avoids the Murrurundi south west and south east industrial investigation areas outlined in the draft Upper Hunter Settlement Strategy.

	• Nil impact on Scone.	• The Study Area has been selected to pass to the west of the existing Scone settlement boundary.
	• Nil impact on the towns of Aberdeen and Blandford.	• The Study Area has been selected to pass to the east of Aberdeen and to the west of Blandford to mitigate any potential impacts on the settlements or proposed investigation areas including the former abattoir site and Aberdeen east.

Class one agricultural land	• The Study Area passes through class one agricultural lands to the north of Aberdeen. Potential impacts include:
	  • Temporary loss of intense productive capacity during construction.
	  • Ongoing loss of intense productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.
		• The outcomes of consultation with landholders would be taken into account in ROW refinement.
		• Terms and conditions of access and compensation would be negotiated with landholders.
		• Endeavour to negotiate terms and conditions relating to construction activities on agricultural land.
		• Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity.
		• Advance notification of potentially disruptive activities would be given.
		• The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

Impact classification	Identified impact	Mitigation measures
Existing major infrastructure	• The Study Area crosses the Main North Railway and New England Highway to the north west of Murrurundi. • Crosses the New England Highway and the south of Scone.	• Chapter 16 of the EA details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.
Environmentally sensitive lands	• Nil impact on the Wingen Maid Nature Reserve and the Towarri National Park.	• The Study Area passes to the east of the Wingen Maid Nature Reserve and the Towarri National Park.
General impact		

Existing or proposed rural residential lots	• The Study Area is contiguous to the Scone west rural residential investigation area outlined in the Upper Hunter draft Settlement Strategy. Potential impact includes:
	  • Sterilisation of land for future rural housing.
	  • Amenity impacts for future housing during operation of the pipeline.
		• Detailed alignment of the ROW would be further investigated to consider potential impacts on the Scone west rural residential investigation area.

General agricultural uses	• The Study Area runs through and contiguous to general agricultural activities. The region is known for general cropping and grazing. Potential impacts include:
	  • Temporary loss of productive capacity during construction.
	  • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.
		• The outcomes of consultation with landholders would be taken into account in ROW refinement.
		• Terms and conditions of access and compensation would be negotiated with landholders.
		• Endeavour to negotiate terms and conditions relating to construction activities on agricultural land.
		• Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity.
		• Advance notification of potentially disruptive activities would be given.
		• The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.7 Muswellbrook Shire

13.7.1 Local government area description

Muswellbrook Shire is at the centre of the Upper Hunter appropriately 130km north west of Newcastle. The Shire has a well-established dairy and beef cattle industry. Viticulture and equine industries are increasingly important to the Shire's economy. The Shire is also home to a number of open cut and underground collieries including the Bengalla and Drayton mines. The principal commercial centre is Muswellbrook.

13.7.2 Statutory plans and zoning

The *Muswellbrook Local Environmental Plan 1985* applies to the Study Area. However it is understood through consultation with Muswellbrook Shire that a new LEP has been released. A review of this new LEP has been identified for further work. Refer to Chapter 18.

The Study Area crosses land within the Shire zoned:

- 1 (a) (Rural ‘A’ Zone) – the objective of this zone is to encourage continued growth in the Shire’s rural economic base. Utility installations are permissible in this zone with development consent.
- 1 (c) (Rural Small Holdings Zone) – the objective of this zone is to encourage rural residential development that minimises the impact on agricultural production. Utility installations (other than generating works) are permissible in this zone with development consent.
- 7 (d) (Environment Protection [Scenic] Zone) – the objectives of this zone are to encourage the preservation of existing wooded hilltops, parts of river valley systems, major scenic corridors, and other local features of scenic attraction and to enable development provided it is carried out in a manner which minimises its visual impact. Utility installations are permissible in this zone with development consent.
- Zone No 7 (L1) (Environment Protection General ‘L1’ [Alluvial Areas] Zone) – the objectives of this zone are to ensure that prime alluvial and irrigable land is preserved for agricultural use and to ensure that any development of non-agricultural nature is located and designed in such a way that the reduction of productive land is minimised. Utility installations are permissible in this zone with development consent.
- Zone No 7 (L2) (Environment Protection General ‘L2’ [Urban Buffer] Zone) – the objective of this zone is to establish a protective buffer of an essentially rural character around Muswellbrook. Utility installations are permissible in this zone with development consent.

13.7.3 Land use impact assessment

Table 13.7 shows the land use impact assessment for Muswellbrook LGA.

Table 13.7 Land use impact assessment – Muswellbrook

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing urban settlements	• Nil impact on Muswellbrook and the town of McCullys Gap.	• The Study Area has been selected to pass to the east of Muswellbrook and to the west of McCullys Gap to mitigate any potential impacts on the settlement
Class one agricultural land	• The Study Area passes through class one agricultural lands to the north of Muswellbrook. Potential impacts include: • Temporary loss of intense productive capacity during construction. • Ongoing loss of intense productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.
Extractive industries	• A significant number of mines are proposed or in operation in and around Muswellbrook. Mines that are within approximately 10km of the Study Area include: • Bengalla. • The Drayton coal mine. • Dartbrook coal mine. • Kayuga coal mine. • Mt Pleasant. • Muswellbrook No. 2.	• The Study Area is located to limit any potential impact on existing or proposed mine operations.
Environmentally sensitive lands	• The Study Area passes through environmentally sensitive land (zoned 7 (d) and 7 (L1–L2) to the north east of Muswellbrook.	• The proposed pipeline will be buried for its entire length. Potential flooding impacts are considered in Chapter 15 and visual character in Chapter 17. • Areas that are visually sensitive would be identified in the CEMP and revegetation carried out in accordance with APIA Code.

Impact classification	Identified impact	Mitigation measures
General impact		
General agricultural uses	• The Study Area runs through and contiguous to general agricultural activities. The region around Muswellbrook is known for general cropping, grazing and equine industries. Impacts include: • Temporary loss of productive capacity during construction. • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated with landholders. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.8 Singleton Shire

13.8.1 Local government area description

Agriculture is one of the main rural land uses within the Singleton LGA and continues to significantly contribute to local economic activity. The main agricultural activities are beef cattle grazing, dairying, viticulture, horticulture and equine activities. Singleton has substantial alluvial areas with high levels of agricultural productivity.

13.8.2 Statutory plans and zoning

The *Singleton Local Environmental Plan 1996* applies to land through which the Study Area passes in the Singleton LGA.

The Study Area crosses land within the Shire zoned 1 (a) (Rural Zone) – the objective of this zone is to protect and conserve agricultural land and to encourage continuing viable and sustainable agricultural land use.

13.8.3 Land use impact assessment

Table 13.8 shows the land use impact assessment for Singleton LGA.

Table 13.8 Land use impact assessment – Singleton

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing or proposed urban settlements	• Nil impact on the villages of Ravensworth, Camberwell and St Clair.	• The Study Area has been selected to pass to the east of Ravensworth and Camberwell and to the west of St Clair.
	• Nil impact on Singleton or Branxton.	• The Study Area has been selected to pass to the north and east of Singleton avoiding Singleton Heights, which is identified as an area for future urban expansion in the draft Singleton Land Use Strategy. • The Study Area has been selected to pass to the north of the town of Branxton.
Extractive industries	• A significant number of mines are proposed or in operation in and around Singleton. Mines that are within approximately 10km of the Study Area include: • The Liddell coal mine. • The Camberwell coal mine. • The Glendell coal mine. • The Glennies Creek coal mine. • The Cumnock No. 1 coal mine. • The Ravensworth East coal mine. • Rixs Creek coal mine. • The Mount Owen coal mine.	• The Study Area is located to limit any potential impact on existing or proposed mine operations.
Environmentally sensitive lands	• Nil impact on the Ravensworth State Forest.	• The Study Area has been selected to pass to the north and east of the Ravensworth State Forest.

Impact classification	Identified impact	Mitigation measures
General impact		
	• The Study Area runs through and contiguous to general agricultural activities. The region around Singleton is known for general grazing, the equine industry and viticulture. Impacts include: • Temporary loss of productive capacity during construction. • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated with landholders. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.9 Maitland City

13.9.1 Local government area description

The Maitland LGA is concentrated around the Maitland town centre, which has a strong retail, health and manufacturing core. Maitland has been a significant area for exploration of mineral resources including coal, sand, gravel, rock and clay. Coal mining in the LGA has declined over the past 20 years with the closure of mining works in East Maitland and cessation of mining along the Great Coal Measures.

The Maitland Rural Strategy identifies the significant agricultural industries in the region as beef and dairy cattle, viticulture, olives, lucerne and poultry.

13.9.2 Statutory plans and zoning

The *Maitland Local Environmental Plan 1993* applies to the Study Area within this LGA.

The Study Area passes through land within the LGA with the following zoning:

- 1 (a) Prime Rural Land – the objectives of this zone are to identify prime agricultural land and require development control to prevent alienation from agricultural use and land degradation. Utility undertakings are permitted within land zoned 1 (a) with development consent.
- 1 (b) Secondary Rural Land – the objectives of this zone are to provide for agricultural uses and animal establishments and to permit appropriate agriculture-related land uses and certain non agriculture-related land uses which will not adversely affect agricultural productivity. Utility undertakings are permitted on land zoned 1 (b) with development consent.

13.9.3 Land use impact assessment

Table 13.9 shows the land use impact assessment for Maitland LGA.

Table 13.9 Land use impact assessment – Maitland

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing or proposed urban settlements	• The Study Area passes contiguous to the following areas identified for possible urban expansion in the Maitland Urban Settlement Strategy: • Maitland Vale (preliminary). • Mt Harris. • Largs. • Thornton North.	• Detailed alignment of the ROW would be further investigated to minimise occupiable residential investigation areas identified in the Maitland Urban Settlement Strategy with the pipeline lateral passing through the Rutherford Industrial Investigation Area and on the eastern floodplain side of the Anambah Preliminary Investigation Area. • Chapter 11 outlines mitigation measures to be employed during construction and operation to avoid impact on residences surrounding the ROW.
Extractive industries	• A significant number of mines are proposed or in operation in and around Maitland. Mines that are within approximately 10km of the Study Area include: • The Abel coal mine. • The Bloomfield coal mine. • The Donaldson coal mine. • The Tasman coal mine.	• The Study Area alignment is located to limit any potential impact on existing or proposed mine operations.
Existing major infrastructure	• The Study Area crosses the Main North Coast Railway and Paterson and Tocal Roads north of Maitland near Bolwarra.	• Chapter 16 details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.
General impact		
General agricultural uses	• The Study Area runs through and contiguous to general agricultural activities. The region around Maitland is known for grazing, dairying, viticulture, turf and poultry production. Potential impacts include: • Temporary loss of productive capacity during construction. • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated with landholders. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.10 Port Stephens

13.10.1 Local government area description

The Port Stephens LGA is a well-known tourist destination and most local industries are responsive to the tourism market. The main local agricultural product is oysters, with the industry worth around $2.4 million per year.

13.10.2 Statutory plans and zoning

The *Port Stephens Local Environmental Plan 2000* applies to the Study Area in and around the Tomago Industrial Estate.

The Study Area passes through land within the LGA with the following zoning:

- 1 (a) Rural Agriculture ‘A’ Zone – the objective of the Rural Agriculture ‘A’ Zone is to maintain the rural character of the area and to promote the efficient and sustainable utilisation of rural land and resources. Utility undertakings are permissible within the Rural Agriculture ‘A’ Zone with development consent.
- 4 (a) Industrial General ‘A’ Zone – the objectives of the Industrial General ‘A’ Zone are to enable the development of a wide range of industrial, service and storage activities and a limited range of business and retail activities. Utility undertakings are permissible within the Industrial General ‘A’ Zone with development consent.
- 6 (a) General Recreation ‘A’ Zone – the objectives of this zone are to provide an open space network to serve the present and future recreational needs of residents and visitors. Utility instillations are permissible within the General Recreation ‘A’ Zone with development consent.

13.10.3 Land use impact assessment

Table 13.10 shows the land use impact assessment for Port Stephens LGA.

Table 13.10 Land use impact assessment – Port Stephens

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing or proposed urban settlements	• The Study Area passes through the Tomago Industrial Estate.	• The proposal is considered to be compatible with the predominant land uses within both the Tomago Industrial Estate.
Existing major infrastructure	• The Study Area crosses the Pacific Highway to the north of the Tomago Industrial Estate.	• Chapter 16 of the EA details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.

Part B

Impact classification	Identified impact	Mitigation measures
General impact		
General agricultural uses	• The Study Area runs through and contiguous to a small area of general agricultural zoned land to the south of the Hunter River. Agricultural activities such as general grazing and turf and poultry production operate in the area. Potential impacts include: • Temporary loss of productive capacity during construction. • Ongoing loss of productive capacity due to location of permanent aboveground infrastructure and/or maintenance activities.	• The outcomes of consultation with landholders would be taken into account in ROW refinement. • Terms and conditions of access and compensation would be negotiated with landholders. • Endeavour to negotiate terms and conditions relating to construction activities on agricultural land. • Construction scheduling would be cognisant of seasonal constraints and compensation would be negotiated for lost productive capacity. • Advance notification of potentially disruptive activities would be given. • The buried depth of the pipeline would ensure that general cropping and grazing activities may be possible on parts of the easement.

13.11 Newcastle City

13.11.1 Local government area description

The City of Newcastle is the economic hub of the Hunter Region and accounts for around 30 per cent of the Hunter's developed industrial space. The Port of Newcastle, the economic and trade hub of the Hunter Valley is Australia's oldest and one of the largest tonnage throughput ports, with coal accounting for over 90 per cent of cargo. Other bulk exports through the port include grains, vegetable oils, alumina, fertiliser and ore concentrates.

Newcastle has a large industrial base, mainly port-related, supported by a range of light and service industries as well as academic, technical and medical institutions.

13.11.2 Statutory plans and zoning

The *Newcastle Local Environmental Plan 2003* applies to the Study Area to the west of the Hunter River and the southern most portion. The zones applying to the Study Area are:

- Zone 4(b) (Port and Industry Zone) – the objectives of this zone are to accommodate port, industrial, maritime industrial, and bulk storage activities which by their nature of the scale of their operations require separation from residential areas and other sensitive land uses.
- Zone 5(b) (Special Uses Reservation) – the objectives of this zone are to reserve land for future essential services including roads, railways, open space and community purposes.
- Zone 7(b) (Environmental Protection Zone) – the objectives of this zone are to provide for the conservation, enhancement and protection of environmentally sensitive land, particularly wetlands.

Under the Newcastle LEP 2003, the carrying out any development for the purpose of a water, sewerage, drainage, electricity or gas undertaking that is at or below the surface of the ground does not require development consent apart from on land zone 7(b). Utility undertakings are, however, permissible with development consent under the 7(b) Environmental Protection Zone.

13.11.3 Land use impact assessment

Table 13.11 shows the land use impact assessment for Newcastle LGA.

Table 13.11 Land use impact assessment – Newcastle

Impact classification	Identified impact	Mitigation measures
Significant impact		
Existing urban settlements	• The Study Area passes through port related land on Kooragang Island.	• The proposal is considered to be compatible with the predominant land uses within the port related industrial land on Kooragang Island.
Existing major infrastructure	• The Study Area crosses port related rail infrastructure and a transport reservation for port infrastructure.	• Chapter 16 of the EA details measures to minimise potential impacts on surrounding infrastructure during construction and operation of the pipeline.
Environmentally sensitive lands	• The Study Area passes through environmentally sensitive lands on Kooragang Island and to the north of the Hunter River.	• Chapter 9 and Chapter 15 identifies mitigation measures to be implemented during construction and operation to limit impacts to environmentally sensitive lands. • Ongoing environmental management in relation to sensitive areas is addressed in Chapter 18.

14 Preliminary hazard and risk assessment

In accordance with the DGRs, a preliminary hazard and risk assessment has been prepared consisting of two parts:

- A qualitative risk assessment based on *AS2885 Pipelines – Gas and Liquid Petroleum – Operation and Maintenance*.
- A quantitative risk assessment (QRA), using the methodology of DoP's Hazardous Industry Planning Advisory Paper (HIPAP) *Guidelines for Hazard Analysis* No. 6 and the risk criteria given in HIPAP No. 4 (DoP, 1992).

The preliminary risk assessment was carried out by Sherpa Consulting Pty Ltd (Sherpa), based on provisional design details, typical pipeline safeguards and conservative assumptions. The risk assessment would be updated and finalised once detailed design and operating procedures are available.

The preliminary risk assessment report has been assessed by Sherpa and is appended to the EA as Appendix J. The following sections provide a summary of the report's findings.

14.1 AS2885 qualitative risk assessment

The objective of the *AS2885* assessment is to identify hazardous incidents that could affect the pipeline resulting in a safety impact to people, loss of supply or affecting the environment. A qualitative assessment of the hypothetical severity and frequency of hazardous events is made taking into account typical pipeline safeguards, which would mitigate the impact of hazards.

Potential hazards arising from the proposed pipeline design, construction, commissioning and operational stages were identified and qualitatively assessed using the methodology of *AS2885.1-2007*. The high level objective of the *AS2885* risk assessment was to ensure that the preliminary design of the proposed pipeline incorporates adequate safety measures and minimises the risk of pipeline incidents during its operation.

The low level objectives of the assessment were to:

- Identify threats to the pipeline that could result in safety, environmental and supply impact.
- Assess whether physical and procedural operational measures are adequate to mitigate the identified pipeline threats.
- Identify where required, additional safeguards to further minimise the risk to personnel, people and property.

After identifying each potential hazard, the associated mode of failure was identified, as well as the consequences of the failure. The typical pipeline safeguards to mitigate the impact of the identified hazards were recorded and taken into account when evaluating the consequences and frequency of the hypothetical incident.

A total of 54 hypothetical incidents were identified and classified by the following risk levels:

- Extreme.
- High.
- Intermediate.
- Low.
- Negligible.

The breakdown of risk levels for the identified hypothetical incidents was:

- No ‘extreme’ or ‘high’ risk level incidents.
- Ten ‘intermediate’ risk level incidents.
- 33 ‘low’ level risk incidents.
- 11 ‘negligible’ level risk incidents.

A summary of the hypothetical intermediate level risk incidents during construction and operation is provided below.

14.1.1 Construction risk

Trench digging

Trench collapse during construction activity was identified as an ‘intermediate’ risk event. There is an increased potential for this type of incident to occur during wet conditions. In the worst case, this incident could result in a fatality. The typical safeguards that would manage the risk of the incident include the following.

- Development of a construction safety management procedure incorporating safeguards associated with this incident.
- Undertaking an excavation risk assessment as required under NSW occupational health and safety (OH&S) legislation.
- Shoring up of trenching, particularly where required to undertake welds at tie-in points.
- Safe work method statements undertaken before entry to trenches.
- The most likely time where access by personnel to the trench would be required is when the pipeline is to be connected to the tie-in points to the existing pipelines at the inlet and delivery stations. At these locations, additional excavation, shoring and alternative access points would be provided where required.

Further risk reduction measures that would also be considered include:

- Implementation of a competency and certification scheme for supervisors and excavation inspectors.
- Inclusion of criteria for when trenching activities cannot occur, eg wet weather or other conditions as determined as a result of a risk assessment.

Safety

These scenarios relate to the type of hazard that may arise during construction activities as a result of equipment failure, inadequate supervision, inadequate procedures, inexperienced or poorly trained staff, etc.

The typical safeguards for these general incidents are the controlled safe work procedures for the type of construction work undertaken. The typical risk reduction measures include the following:

- Specification of safety requirements as part of contractor selection process.
- Implementation of a safety management plan for construction activities including contractor management.
- Regular safety audits/inspections of workplaces.
- Approval of equipment to be used for construction work.
- Competency system implemented for relevant tasks.
- Safe work method statements for relevant tasks.

Further improvements to the management of the OH&S risk exposures would include:

- Regular safety audits (management system and workplace inspections) carried out by independent party.
- A risk register and risk minimisation process.

Construction along roads

Incidents involving impacts on the public or construction personnel could occur due to the proximity of vehicle traffic near construction work. People may be impacted by vehicle incidents or construction equipment and activity or as a result of a person being distracted during construction.

The typical safeguards that would manage the risk of such incidents include:

- Development of a traffic management plan incorporating requirements for traffic management during construction work and after hours.
- Access barriers, warning signs at construction areas and access point's and/ or separation distances between construction areas and roadways.
- Awareness training prior to commencement of construction activity.
- Liaison with local councils and/or the RTA to review the traffic management plan and proposed construction activities.
- Review requirements for single lane operation where required during periods of construction activity.

Construction in forest (bushfires)

Construction activity such as welding and grinding activity, vehicle use or personnel smoking could result in bushfires if not controlled. This is especially important during hot days with very high and extreme bush fire danger and could potentially result in a major bushfire.

Typical safeguards to minimise the risk include the following:

- Restriction and control of all ignition sources.
- Total project ban on the lighting of fires.
- Provision of fire fighting capabilities, both physical equipment and competent operators.
- Minimisation of combustion material in the vicinity of heat related activities (eg welding).
- Equipment maintenance.

Further risk reduction of such events would include:

- Liaison with local fire authorities to establish daily fire danger.

- Restriction of work activity during high fire danger periods.
- Liaison with local fire authorities and review and approval of proposed fire fighting controls.

Construction near power lines

Construction activity such as crane lifts could result in contact or arcing at power lines if safe clearances are not maintained.

Typical safeguards to minimise this risk include the following:

- Restriction on the type of equipment allowed on the ROW.
- Training and certification of equipment operators.
- Use of spotters when working with lifting equipment under power lines.

Further risk reduction of such events would include:

- Construction work would be conducted in compliance with the Energy Supply Association of Australia (ESAA) guidelines for *Safe Approach Distance to Electrical Apparatus* fire danger.
- The potential hazard would be included in Construction Safety Management Plan.

14.1.2 Operational risk

Third party impact

Third party construction and farming activity (eg fence post digging, deep ploughing and roadworks) could result in damage to the pipeline, potentially leading to a major release and fatality if people are the area. This is the most common mode of pipeline incidents. This hazard is one of the key issues for design, construction, operation and maintenance addressed in *AS2885*.

Seismic activity

This incident has been assessed as an 'intermediate' risk. It is assumed that the Hunter Valley region is a seismic active area, considering earthquakes have struck in the Newcastle area. Although an earthquake rarely results in pipe failures, it is a possible outcome. To better understand the possibility of earthquake in the area and its potential impact, the relevant authorities would be contacted to evaluate this and, consequently, review this risk issue as part of the final risk assessment. Typical safeguards include:

- Physical integrity of pipeline (wall thickness, etc).
- Depth of cover.
- Emergency response plan with regular drills.

To reduce the impact of this event, appropriate siting of valve stations would be required to meet the requirements of *AS2885.1-2007*.

Pipeline near mining leases

Mining activity on leases located near the pipeline could result in impact on the pipeline. This could be due to mine subsidence or seismic impact from blasting activity.

The typical safeguards include:

- Pipeline route selection to avoid mining leases.
- Liaison with local mining companies to establish extent and timing of mining activity near pipeline.

- Conducting regular pipeline surveillance.
- Implementation of an emergency response plan with regular drills.

The Mine Subsidence Board has provided the project team with their requirements for the proposed pipeline. This includes requirements to identify coal resources and old mining areas along the Study Area, as well as the need to demonstrate the structural integrity of the pipeline is adequate near known subsidence areas.

Stress corrosion cracking

Stress corrosion cracking is a phenomenon that can occur in pipelines that are subject to pressure cycles under high operating temperatures and in soil conditions that are conducive to corrosion. If detected, stress corrosion cracking may require pipeline repairs or may require derating of the pipeline. If undetected, stress corrosion cracking may lead to pipeline failure.

Detailed pipeline design would make allowances to minimise the impact of stress corrosion cracking such as by selecting an appropriate pipeline coating which would minimise the impact of external corrosion, and by providing an appropriately designed CP system.

It has been recommended that the proposed pipeline design be assessed against the Pipeline Research Council International protocol for the assessment of likelihood of stress corrosion cracking. Because of the typical safeguards and the low likelihood of stress corrosion cracking impact, no increase in the failure rate for stress corrosion cracking was included in the frequency analysis.

Acid sulphate soils

When ASS are excavated and exposed to oxygen, sulphuric acid is produced in large quantities. During the operational phase of a pipeline residual acid may result in pipeline corrosion. Typical management procedures to mitigate the effect of ASS include:

- Limited excavation to minimise the length of open trenches and the time exposed in affected areas.
- Lime neutralization.
- Spoil management, including segregated storage of acidic spoil stockpiles away from watercourses and appropriate treatment and disposal methods.

Powerlines

The impact of power lines near gas pipelines is a well known hazard and can give rise to additional hazards to the pipeline and to personnel operating and maintaining equipment, eg mobile equipment (such as cranes) contacting overhead power cables and becoming energised and leading to shock and electrocution to personnel operating the equipment.

Typical safeguards to minimise the risk of identified hazards include:

- During construction, providing a safe working environment and complying with safety requirements for work near overhead powerlines
- During operation, adopting safety measures to ensure the safety of personnel and equipment.

AC Corrosion

AC corrosion can occur at voids or defects in the pipeline coating as a result of the impact of AC induction near power lines. The impact of AC corrosion would be assessed in the detailed design to verify that load current levels are mitigated to a value below the critical value that would result in a high likelihood of impact.

14.2 Quantitative risk assessment

The methodology for undertaking the QRA is as described in the DoP guidelines, HIPAP No. 6 and HIPAP No.4. The level of assessment was determined by use of the advice document 'Multi-level Risk Assessment' with the most rigorous QRA level, Level 3, chosen for the assessment. The QRA consisted of the following steps:

- Hazard identification to identify the potentially hazardous incidents that could result in impact to surrounding land uses.
- Consequence assessment in terms of distances to consequence levels which could potentially impact members of the public.
- Frequency assessment of the hazardous incidents.
- Risk calculation of hazardous incidents by multiplying consequence and frequency.
- Comparison of these calculations with DoP risk criteria, as described in HIPAP No. 4, for fatality risk in a million per year by land use and distance from the pipeline.

The hazard identification showed that the main issue of concern that could result from the operation of the pipeline is a loss of containment leading to a release of high-pressure CSG to the environment and subsequent ignition. The main types of failure incident reported are:

- External interference from heavy equipment (eg mechanical damage to pipe during excavation by third parties).
- Scour damage (eg river bed scouring, exposing and damaging pipes).
- Construction and material defects.
- Internal and external corrosion and stress corrosion cracking.
- Subsidence damage (eg banks and levees washing away, exposing and damaging pipes, mine subsidence, construction work near the pipeline).
- Faulty construction (eg welding defects and lack of weld testing).
- Ground movement (eg buckled pipework from excessive ground movement from earthquakes, slips and ground subsidence).
- Error during 'hot tapping'.

14.2.1 Pipeline safeguards

The proposed pipeline would be designed and operated in accordance with *AS2885.1-2007* meeting the requirements for the appropriate location class as per Clause 4.3.4 of *AS2885.1-2007*. These location classes are summarised as follows:

- Rural (R1) – typically undeveloped land or land used for rural activities such as grazing or agriculture, with isolated dwellings and infrastructure serving the local land uses.
- Rural residential (R2) – typically land occupied by single residence blocks, typically in the range of one to five hectares, or which is zoned rural residential.
- Residential (T1) – typically land developed for community living, with multiple dwellings in close proximity.

- High density (T2) – typically land developed for high-density community living, with multiple dwellings and multi-storey development.

The Study Area passes near regions that range from R1 (open isolated rural areas with limited dwellings) to T1 areas. However, the Study Area generally avoids built-up residential areas, even at the Tomago and Kooragang Island areas, where the Study Area is near industrial areas.

The following engineered and procedural safeguards are typical of pipeline designs and would be considered for inclusion in the design as appropriate to the location class:

Protection against external damage

- Marker signs.
- 'One-Call'/'Dial Before You Dig' services.
- Pipeline patrols.
- Marker tape.

Corrosion Protection

- External coating of pipeline.
- 'Holiday' detection (testing of coating integrity) prior to burial.
- Impressed current CP system.
- Gas quality with minimal corrosion enhancing components.
- Intelligent pigging to assess pipeline condition.

Ground movement/subsidence

- Regular pipeline patrol to facilitate detection of any ground movement or land subsidence to that investigation can be carried out.
- Pipeline design to make provision for current subsidence parameters for the location (provided by the Mine Subsidence Board).
- Liaison with the Mine Subsidence Board to determine likely future mining activity.
- Where significant ground movement has been detected and stresses are determined to be high, the ground around the pipeline will be dug up to relieve the stresses on the pipe as an additional precautionary measure to mitigate the effect of subsidence.

14.2.2 Assessment results

The hypothetical incidents carried forward for risk assessment were pipeline releases resulting in the release of gas with potential for ignition. The results of the QRA for these incidents were presented as risk transects, showing the accumulated individual risk levels at any lateral distance from the centreline of the pipe. The transect developed for the base case (11.2mm wall thickness pipe, buried at a depth of 750mm for most of the pipeline), which is representative of most of the pipeline, shows that the individual risk reaches 1 x 10^{-6} per year (HIPAP No. 4 criteria for residential areas) at a distance of about 105m from the centreline of the pipeline.

Individual risk

Risk transects showing the fatality risk versus the distance from the centerline of the pipe were produced for a number of cases depending on the safeguards proposed (depth of cover and concrete capping).

The distances required to meet the HIPAP No. 4 risk criteria for each land use case are summarised in Table 14.1. These represent the separation distances required to ensure that the risk from the pipeline meets the HIPAP No. 4 criteria.

Table 14.1 Pipeline risk assessment results

Safeguard cases	Required separation distance to meet recommended fatality risk levels (m)				
	Sensitive land use (0.5×10^{-6} per yr)	**Residential (1×10^{-6} per yr)**	**Commercial (5×10^{-6} per yr)**	**Active open space (0.5×10^{-6} per yr)**	**Industrial (50×10^{-6} per yr)**
Base case – 750mm depth of cover (DOC)	140	105	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
900mm DOC	132	103	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
1,200mm DOC	121	92	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
Marker tape, 750mm DOC	116	80	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
Marker tape, 900mm DOC	112	60	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
Marker tape, 1200mm DOC	106	35	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
Marker tape, 1400mm DOC	104	17	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
Marker tape, 900mm DOC with concrete capping	45	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
Marker tape, 1,200mm DOC with concrete capping	35	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance
Marker tape, 1,400mm DOC with concrete capping	30	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance	Risk level not reached at any distance

Societal risk

Societal risk is a measure of society's concerns for risks that result in multiple fatalities. For example, people may be concerned with the risks of aircraft crashes based on reporting of incidents with high casualty figures. By comparison, people may be less concerned with the risks of motor vehicle accidents, which occur on a daily basis and do not receive the same level of public attention.

Societal risk is calculated by assessing the impact to the entire population around the facility and therefore depends on the population density in the area. Given the low population density in the vicinity of the Study Area and the low individual risk, the societal risk level resulting from the pipeline operation would be negligible and has not been quantified.

14.3 Update assessment during design phase

As a result of the *AS2885* qualitative risk assessment, safeguards additional to the typical safeguards have been suggested for 'intermediate' risk events in the preceding section to reduce these risk events to as low as reasonably practical levels. The mitigated risk levels incorporating these additional measures have not however, been assessed at this stage. The pipeline designer would assess these additional risk reduction measures for adequacy and suitability during the detailed design stage and the relevant measures incorporated into the final risk assessment.

In addition, the actions recommended for 'low' risk events (refer to Table A2.1 in Appendix 2 of Sherpa's Report in Appendix J) would be implemented in line with the as low as reasonably practicable principle to reduce the risks even further. The proposed pipeline design would also be assessed against the Pipeline Research Council International protocol for the assessment of likelihood of stress corrosion cracking.

The results of the QRA were compared with the relevant criteria for risk given in HIPAP No.4. Preliminary details of land uses near the Study Area were reviewed. The results given in Table 14.1 would be used by the pipeline designer to provide an appropriate level of safeguards at any point on the pipeline to ensure that the risk levels meet the HIPAP No. 4 criteria.

In summary:

- The pipeline designers would use the distances summarised in Table 14.1 above to determine an appropriate level of safeguards when finalising the pipeline alignment to ensure that the risk levels meets the *HIPAP No. 4* risk criteria, including changing the pipeline alignment near sensitive land uses to meet acceptable risk criteria.
- The QRA would be updated following the guidelines of HIPAP No.4 when details of the design and location of the pipeline are finalised.

14.4 Mitigation measures

The preliminary qualitative and quantitative assessments of hypothetical hazards and risks considered a range of typical safeguards and additional risk reduction measures for the identified potential risk events. These assessments would be updated for the final pipeline design. Typical safeguards for cross-country pipelines that would be used by the QHGP proposal are included in Table 14.2.

Table 14.2 Hazard and risk mitigation and management measures

Potential risk	Proposed mitigation and management measures
Construction safety	• Development of a Construction Safety Management Plan incorporating safety requirements and procedures.
External damage	• 'One –Call'/'Dial Before You Dig' services. • Marker tape buried in trenched sections along the whole length of the pipeline. • Permanent line-of-sight marker posts installed along the centre line. • External coating of pipeline. • CP systems with regular corrosion monitoring, • Additional protection measures where required near power line easements to reduce the risk of voltage induction effects.
Seismic activity	• Increased wall thickness where required by local conditions. • Minimum depth of cover 750mm with additional depth of cover. • 'Snaking' the pipe in the trench for additional slack.
Subsidence	• Pipeline design and route selection would be undertaken to make provision for current subsidence parameters for the location (provided by Mine Subsidence Board). • Liaison with the Mine Subsidence Board to determine likely future mining activity.
Operational	• Intelligent pigging to assess pipeline condition. • Ground and aerial pipeline patrols along the easement.

15 Surface and groundwater

This chapter provides a summary of the tiered assessment of the potential impacts relating to surface and groundwater. The proposed pipeline would cross many major and minor watercourses, and would be located in the vicinity of groundwater bores. This chapter outlines the methodology adopted to assess all potential impacts, followed by recommendations regarding mitigation and management measures. These recommendations take a standard approach as well as taking into account sites that require further site-specific assessment. Details of each water feature that lies within the Study Area, the corresponding KP's and sensitivity ratings are given in Appendix K.

15.1 Assessment approach

15.1.1 Data sources

Surface watercourses and groundwater bores were identified over the entire length of the QHGP, sourcing data from:

- Commonwealth Geoscience Australia.
- DWE.
- DECC.

The sensitivity of the watercourses has been determined based on data from:

- Aerial photography / GIS analysis/ topographical maps.
- Department of Natural Resources' stream categories (NSW Government Gazette No 37 Sch 4, 2006).
- Classification and Characteristics of Waterway Type (Fairfull and Witheridge, 2003).
- SEPP 14 listing / RAMSAR listings.
- Water bore licenses.

This part of the EA is based on desktop information only. There are therefore limitations with the data used to inform the assessment. As such, the methodology presented reflects an adaptive management approach, by way of:

- Targeted field investigations to inform site-specific mitigation and management measures at identified watercourse crossings.
- Ongoing consultation with land owners, to understand localised surface water and groundwater impacts, such as local bore water use and on site water storage (dams) that have not been captured from the desktop data review.
- Continued site investigations to identify drainage lines not captured by the desktop data. These features are intermittent in nature, ie they are drainage lines that only contain flowing waters during rain events.

15.1.2 Methodology

Surface water

A tiered environmental assessment on watercourses has been undertaken. The process conducted is described, in the order of assessment, below. Appendix K provides, on a regional basis, a summary of the assessment in tabular format, for each water feature that may be intercepted by the proposal.

Watercourse identification

Based on the data sources given in Section 15.1.1, all watercourses that would be traversed by the Study Area were identified. To maintain a consistent assessment across the entire QHGP Study Area, only data that represented hydrography was used to identify watercourse features such as lakes, reservoirs, dams, rivers and creeks.

Watercourse sensitivity

Each watercourse within the Study Area intersected by the proposed pipeline, was categorised according to its sensitivity based on the criteria in Table 15.1.

Table 15.1 Sensitivity criteria – water quality and hydrology

High sensitivity	Moderate sensitivity	Low sensitivity
• Good intact native riparian vegetation[1]. • Highly sensitive downstream water users[1]. • First or second class stream according to the Department of Primary Industries' Fish Habitat Classes[3]. • SEPP 14 or RAMSAR listed wetlands downstream[4].	• Moderate riparian vegetation, with some native species present. • Less sensitive downstream water users (eg may tolerate temporary increase in sediment load). • Third or fourth order stream according to the Department of Natural Resources' stream categories[2]. • Third class stream according to the DPI' Fish Habitat Classes. • Shallow water tables (less than 1.5 m deep)[5].	• Ephemeral stream. • No threatened species habitat. • No riparian vegetation – highly disturbed. • First or second order stream according to the Department of Natural Resources' stream categories. • Fourth class stream according to the DPI' Fish Habitat Classes.

Information sources:

1 Aerial photography / GIS analysis/ topographical maps
2 Department of Natural Resources' stream categories (NSW Government Gazette No 37 Sch 4, 2006)
3 Classification and Characteristics of Waterway Type (Fairfull and Witheridge, 2003)
4 SEPP 14 listing / RAMSAR listings
5 Water bore licenses

The sensitivity criteria in Table 15.1 uses the Strahler system to assess the watercourse itself and the DPIs Fish Habitat Classes to assess the potential impacts on aquatic fauna. Specific assessment of the presence of, and impacts on endangered or threatened species, is conducted in the biodiversity assessment of the EA (refer to Chapter 9).

The Strahler system is a method for determining the stream order of watercourses. The Strahler system classifies stream size, based on a hierarchical method. It starts at the top of a catchment and any watercourses that do not have any other watercourses flowing into it are labelled as a first order stream. Where two first order streams join together, that stream then becomes a second order stream. This pattern continues for third and fourth order streams, where a third order stream does not become a fourth order stream until it is joined by another third order stream. Thus, a first order stream within the Strahler system is likely to be a minor watercourse. The Fish Habitat Classes work in the reverse order, with a 1st class fish habitat being the most sensitive.

Watercourse crossing review

Each watercourse was then reviewed in relation to the potential construction techniques. Common pipeline construction methods available for the crossing of watercourses are discussed in Chapter 5. These are:

- Open cut with or without flow diversion (depending upon the flow of water in the watercourse and down stream sensitivities).
- HDD.

The application of the various techniques for watercourse crossings is dependent on a number of factors (refer Section 15.5), including sensitivity. As a guide, an open cut trench, with or without flow diversion, would be used on all low and moderate sensitivity watercourses. HDD would only be used on high sensitivity crossings where the impacts of open trench crossing were not acceptable. The proponent would engage with DECC, DPI and DWE with regard to crossing methods and site specific management measures for high sensitivity watercourse crossings.

Potential impacts on watercourses are presented in Section 15.3 and standard mitigation and management measure are proposed in Section 15.4.

Groundwater

All known groundwater bores were plotted in relation to the Study Area (refer to Figures K1-K17 in Appendix K).

Based on the data sources listed in Section 15.1.1 the groundwater bore levels were determined and compared to the likely depth of construction of the pipeline (ie 1.2m below ground level based on 700mm cover and 500mm pipe diameter). The potential impacts on groundwater were then assessed (refer to Section 15.3).

15.2 Existing environment

15.2.1 Surface water

The proposed pipeline would cross a total of 176 watercourses, the crossings are based on desktop analysis, and can be categorised as:

- 33 crossings reflecting high sensitivity, this includes crossings within the Gwydir, Boomi, Quirindi, Hunter, Macintyre/Barwon, Namoi and Pages systems.
- 20 water crossings reflecting moderate sensitivity.
- 126 water crossings reflecting low sensitivity.

It is noted that the majority of watercourse crossings were through non-perennial watercourse features (intermittent flow). These were identified as generally being of low sensitivity.

Sensitive wetlands (such as RAMSAR or SEPP 14 wetlands) have been avoided, for the most part, throughout the Study Area. The Gwydir and Hunter Estuary RAMSAR wetlands, which have been identified as being of high sensitivity, are fed by watercourses crossed by the proposed pipeline. The Gwydir wetland is approximately 10km downstream to the west-north-west of the Study Area at approximately KP337 and KP339. The Hunter Estuary wetland is adjacent to the Study Area at KP816 to KP825, located approximately 1km to the east-north-east.

The Study Area is within the following CMAs:

- Border Rivers-Gwydir.
- Namoi.
- Hunter-Central Rivers.

Consultation has been undertaken with the relevant CMAs (refer to Chapter 6).

Drinking water sources have been located in relation to their relevant CMA.

Border Rivers – Gwydir CMA

There are no drinking water storage facilities in proximity to the Study Area.

Namoi CMA

The main catchments within this region include:

- Quipolly Dam which is located north of Quirindi.
- Keepit Dam which is located to the north east of Gunnedah on the Namoi River.

The Study Area intersects downstream from the above noted water storage facilities and would therefore not impact on water storages in this area.

Hunter-Central CMA

Hunter Water provides water services to three of the local government areas along the Study Area. These include Newcastle, Port Stephens, and Maitland. It also provides a small supply of water to Singleton. The three main catchments for Hunter Water include:

- Grahamstown Dam catchment supplies approximately 40 per cent of the Lower Hunter's water supply. It is an off river storage that is primarily used to store water extracted from the Williams River.
- Chichester Dam contributes to approximately 35 per cent of the Lower Hunter's water supply. It is located at the top of the Williams River catchment.
- Tomago and Anna Bay Sandbeds are groundwater reserves that cover an area of 275km^2 and extend from the Hunter estuary to Port Stephens, and to Raymond Terrace in the west. Tilligerry Creek is the most prominent surface drainage feature into this groundwater reserve.

The Study Area does not intersect the Williams River or Tilligerry Creek. Therefore, there would be no impacts on the catchments within this region.

To the north of the Hunter-Central catchment, two main water storage facilities have been identified, they include:

- Lake St Clair (Glennies Creek Dam) is located 25km north of Singleton and provides water for the town of Singleton and operates in conjunction with Glenbawn Dam.
- Glenbawn Dam is located approximately 15km east of Scone.

The Study Area intersects downstream from the above noted water storage facilities and would therefore not impact on water storages in this area.

15.2.2 Groundwater

Groundwater sources along the Study Area have been obtained from the relevant CMAs.

Groundwater sources within the Hunter-Central Rivers CMA include:

- Hunter River Alluvium.
- Tomago-Tomagree-Stockton Sandbeds.
- Kingdom Ponds and Tributaries Alluvium.
- Pages River Alluvium.
- Goulburn River Alluvium.
- Tuggerah-Gosford Coastal Sands.
- Sydney Basin.
- Gunnedah Basin.

Groundwater sources within the Namoi CMA generally fall within in the proximity of the towns Quirindi, Gunnedah, Boggabri, Narrabri and Wee Waa.

Groundwater sources within the Borders Rivers – Gwydir CMA include the Great Artesian Basin Alluvial.

The Study Area may fall within the regions of these groundwater sources. The location and depths of groundwater bores along the Study Area has been mapped (refer to Appendix K). The depth of trench excavation is not likely to impact on groundwater sources.

Those groundwater levels shown two metres or less have been noted in Section 15.4.2.

15.3 Potential impacts

15.3.1 Construction

The majority of watercourse crossings are through drainage lines that experience surface water flows only during rain events and are therefore dry for the most part. Trenching is a suitable crossing method for drainage lines of low sensitivity. Surface water impacts are considered negligible when these watercourses are dry.

Potential impacts to other water features that may result from the proposal during construction are:

- Changes in waterway channel or bank form. This may result from loss of riparian vegetation and lead to increased erosion potential or geomorphologic impacts. This would be particularly evident in areas of good, intact native riparian vegetation or in areas of sensitive waterway morphology. The extent of sedimentation is dependent on bank and stream bed material, flow velocity and existing vegetation.
- Pollution of surface and groundwater**.** Water pollution could potentially result from erosion and sedimentation, disposal of water used for hydrostatic testing and spills of fuels and chemicals during construction. This impact is only applicable to watercourses that are experiencing water flow at the time of construction. This could have downstream impacts on water dependent ecosystems, recreational uses or water extraction users.
- Potential during HDD for the drill bit to intersect a fracture within the riverbed of a watercourse crossing. When this occurs, bentonite mud may be released into the watercourse. This event is referred to as a 'frac out' and could cause increased turbidity until the material is fully dispersed.

- Changes to existing surface and groundwater flow regimes**.**

Relevant impacts that may influence water quality, from a whole of catchment perspective, are related to pollution of surface and groundwater and changes to existing surface water and groundwater flow regimes. As noted in Section 15.2.1 no direct impacts are anticipated to drinking water supplies as a result of the construction or operation of the proposed pipeline. A residual impacts assessment of significant water resources within a catchment is provided (refer to Section 15.4.2).

Groundwater levels in the bores in the vicinity of, or within the Study Area, were mostly below the trench excavation level of the proposed pipeline, ie generally greater than 1.2m below ground level. Where this was not the case it was noted (refer to Appendix K).

Based on the known groundwater levels in registered bores, impacts to groundwater are considered minor. Although it is unlikely that the proposal would impact groundwater resources, site-specific consideration of the pump out of groundwater collected in trenches is considered necessary. Mitigation and management measures for potential impacts to groundwater are presented in Section 15.4.

15.3.2 Operation

During operation, potential impacts to the water environment are considered to be limited to changes to existing surface and groundwater flow regimes that may result from placement of the pipeline and associated bedding materials within the soil profile.

Pipeline trenches would be backfilled with material excavated from the trench and would be of the same regional soil profile. Surface contours would be matched to existing, apart from a residual soil berm, which would flatten over time. For a short term period after construction, the emplacement of backfill into the trench would form a berm (crown) to allow for future settlement. Due to the linear alignment, during rain events, scouring and local ponding effects may occur as the crown presents a surface water flow barrier.

Long term impacts to surface and groundwater are considered minor to negligible.

15.4 Mitigation and management measures

15.4.1 Standard approaches

Potential impacts relating to surface and groundwater would, in most cases, be manageable through the implementation of standard mitigation and management measures as outlined in Table 15.2.

Table 15.2 Surface and groundwater mitigation and management measures

Potential impacts	Mitigation and management issues

Changes in waterway channel or bank form.	• Waterway crossing techniques would be selected in consultation with DECC, DPI and DWE taking into account the sensitivity of the waterway crossing.
	• The disturbance corridor for the bed, bank and approaches to watercourses will be the narrowest practicable for safe construction. However, a wider ROW and work area will be required for watercourses with deep and steep banks.
	• Where practicable, crossings would be undertaken during no or low flow conditions.
	• Bank restoration techniques would be adopted where practicable. Techniques include:
	  – Stabilising watercourses where required by establishing rocks, sandbags, and/or matting to prevent scouring, ensuring that they are placed to conform as far as possible with existing contours.
	  – The re-spreading of topsoil over the area from where it was removed.
	  – Installing matting that is infused with seedlings in order to keep the soils stable while it settles.
	  – Cleared scrub being piled onto banks to stop cattle and stock eroding the bank structure, where practicable.
	  – Where practicable, the installation of silt and sediment fences to filter surface runoff water.
	  – The replacement of ‘snags’ and other structures of potential fishery value that would have been disturbed during the construction period.
	  – The reinstatement of any drainage lines that have been disturbed.
	  – The terracing or installation of surface water diversion berms that would be placed along the top and immediate points down the bank slope to encourage runoff to discharge onto stable (vegetated) areas or via sediment settling basins, this would be established to prevent runoff running directly into the watercourse.
	• HDD would be used on selected watercourses where practicable, taking into account environmental, engineering, logistical, geotechnical issues and advice from the HDD contractor and consultation with DECC, DPI and DWE.

Pollution of surface and groundwater.	• Soil and water management proposals are to be implemented for the construction phase via the CEMP. These proposals would be prepared in accordance with *The Blue Book (Managing Urban Stormwater: Soils and Construction)* appropriate to pipeline construction such as:
	  – Diversion of ‘clean’ surface runoff around and away from working areas to prevent erosion
	  – Directing ‘dirty’ runoff from work areas into sediment control devices (such as geotextile sediment fences, gravel socks or geologs) installed downhill of disturbed areas, particularly near watercourses and around stockpiles.
	  – Appropriately containing water pumped from trenches and disposal through sediment socks or settlement control devices to allow sediment to settle out prior to discharge to the environment.
	  – Trench water to be discharged to stable ground away from the stream bed.
	• A hydrostatic test water disposal procedure would be implemented via the CEMP and include requirements for potential water treatment and disposal, refer also to Section 17.1 (Resource waste management). All stockpiles (vegetation, bed material, bank material) would be stored separately. Silt fences would be located on the lower side of stockpiles and installed between the watercourse and the construction area to minimise sediment releases (whether or not water is present).
	• Soils would be graded away from the watercourse, not towards it.

Potential impacts	Mitigation and management issues

	• Monitoring and reporting procedures would be established within the CEMP for the following areas:
	  • Erosion control and sediment collection devices.
	  • The water quality of upstream and downstream areas from the crossing.
	  • Watercourses post construction.
	• A spill response procedure would be developed in the CEMP for the construction phase of the project. This would address fuels, lubricants and other chemicals. The spill response procedure would include aspects such as:
	  • Spill response equipment is to be located at each work site.
	  • Drilling fluid spill (frac-out) prevention and response procedures (including geotechnical investigations).
	  • Maintenance or refuelling of mobile equipment and vehicles should not be conducted within 150m of any surface water body.
	  • Storage sites are not to be located in the vicinity of any waterway.
	• The following mitigation measures would be applied to minimise the potential for a ‘frac out’ incident:
	  • Geotechnical investigations would be carried out prior to drilling to provide a better understanding of the prevailing conditions and the type of drill equipment required.
	  • The entry and exit locations would normally be set well back from the watercourse to enable the pipe to be located well below the bed of the watercourse, thus reducing the potential for break through.
	  • Where a frac out has occurred measures would be taken to seal off the drill hole. The drill may need to be abandoned and an open cut crossing would need to be undertaken.
	  • Should groundwater be encountered during construction activities, appropriate management measures would be implemented to minimise the risk of polluting surface water or groundwater. This may include such measures as water testing, dewatering, temporary water storage and treatment facilities.

Changes to existing surface and groundwater regimes.	• Where Water Sharing Plans under the *Water Management Act 2000* apply to areas of the Study Area, water access licensing is not required for the proposal given that it is a critical infrastructure project and exempt by section 75U of the EP&A Act from sections 89, 90 and 91 of the *Water Management Act 2000.* Should any groundwater extraction be required, the requirements of the relevant Water Sharing plan would be complied with or the Water Act 1912, as the case may be. • Trenches are to be backfilled with the material that was removed in that location to prevent the formation of any barriers to groundwater movement across them. • Trench-breakers are to be installed at either side of each waterway crossing to prevent any preferential flows of groundwater along the trench (Refer to Chapter 5). • Trench backfill is to be compacted and reinstated to compensate for settling of trench backfill. Where crowns are used crown breaks are to be created at regular intervals and at drainage lines to permit continued surface water flows and prevent scouring along the trench or ponding on the easement. • The location of any nearby groundwater bores are to be mapped and the pipeline route is to avoid these bores. • In circumstances that would require dewatering, pumping rates would be determined by aquifer thickness and permeability. The dewatering designs would incorporate consideration of the likely impacts to nearby existing groundwater users. • No permanent above-ground structures are to be placed within floodways that would impede flood waters.

The Hunter River would be crossed by HDD at KP812.5 and KP816. This crossing method would avoid sensitivities on the river at these crossing points related to the:

- Likelihood of high flows (3^{rd} or 4^{th} order streams).
- Importance of fish passage (1^{st} or 2^{nd} class streams).
- High probability of actual or potential ASS present.
- Presence of SEPP 14 or RAMSAR listed wetlands downstream.

15.4.2 Residual impacts assessment

A review was undertaken to identify significant water resources, such as wetlands, drinking water sources, aquifers and groundwater resources. Residual impacts were assessed after the application of mitigation and management measures.

Watercourse crossings

Based on an understanding of watercourse sensitivity and crossing method, the effectiveness of proposed mitigation measures were assessed (refer to Appendix K). Fieldwork was considered to be required where the standard construction mitigation and management measures (refer to Table 15.2) may need to be supplemented by a more detailed understanding of watercourse sensitivity, the probable crossing technique employed and the potential impacts (refer to Section 15.5).

Wetlands

Whilst the majority of wetlands have been avoided they are still sensitive to upstream impacts during construction. Within the sensitivity criteria, crossings that feed into downstream environments, such as RAMSAR wetlands, are considered as being of high sensitivity. For this reason, the following river crossings have been identified as being of high sensitivity:

- Barwon River, Gnowra River, Mehi River – as they flow into the Gwydir Wetlands.
- Hunter River crossings – as they flow into the Hunter Estuary wetland. As noted in Section 15.4.1, the Hunter River would be crossed by HDD at KP812.5 and KP816.

Drinking water sources

No residual affects were determined in relation to drinking water resources.

Aquifers

No residual affects were determined in relation to aquifers.

Groundwater and soils

The sensitivity of the area to be traversed by the pipeline is influenced by soil type and groundwater:

Known areas of high risk for actual or potential ASS. This is prevalent in the Newcastle and Muswellbrook regions.

Groundwater levels at shallow depths (two metres below ground level or less). This is noted in two regions: the Murrurundi region (KP633 to KP635) and the Muswellbrook region (KP692 to KP694). Shallow groundwater may be encountered in other areas during construction. Consultation with landholders and relevant authorities is continuing to assist in the identification of areas of potentially shallow groundwater and related issues, such as salinity and shallow groundwater near Bellata. The area sensitivities are mapped regionally and are provided in Appendix K. Mitigation measures are noted in Table 15.2 and are also considered in Section 17.3.

15.5 Fieldwork

15.5.1 Water features requiring fieldwork

Based on the residual impact assessment 30 watercourse crossings were assessed as being of high sensitivity. Of these, 28 watercourse crossings are considered to be appropriate for fieldwork due to their potential high sensitivity to impact during construction (refer to Table 15.3). Impacts to the Hunter River would be mitigated by HDD at KP812.5 and KP816 (refer to Section 15.4.1). Fieldwork, in conjunction with consultation with DPI, DECC and DWE, would assist in determining the watercourse crossing location, methodology and required site-specific mitigation measures.

Table 15.3 Watercourse crossings requiring fieldwork

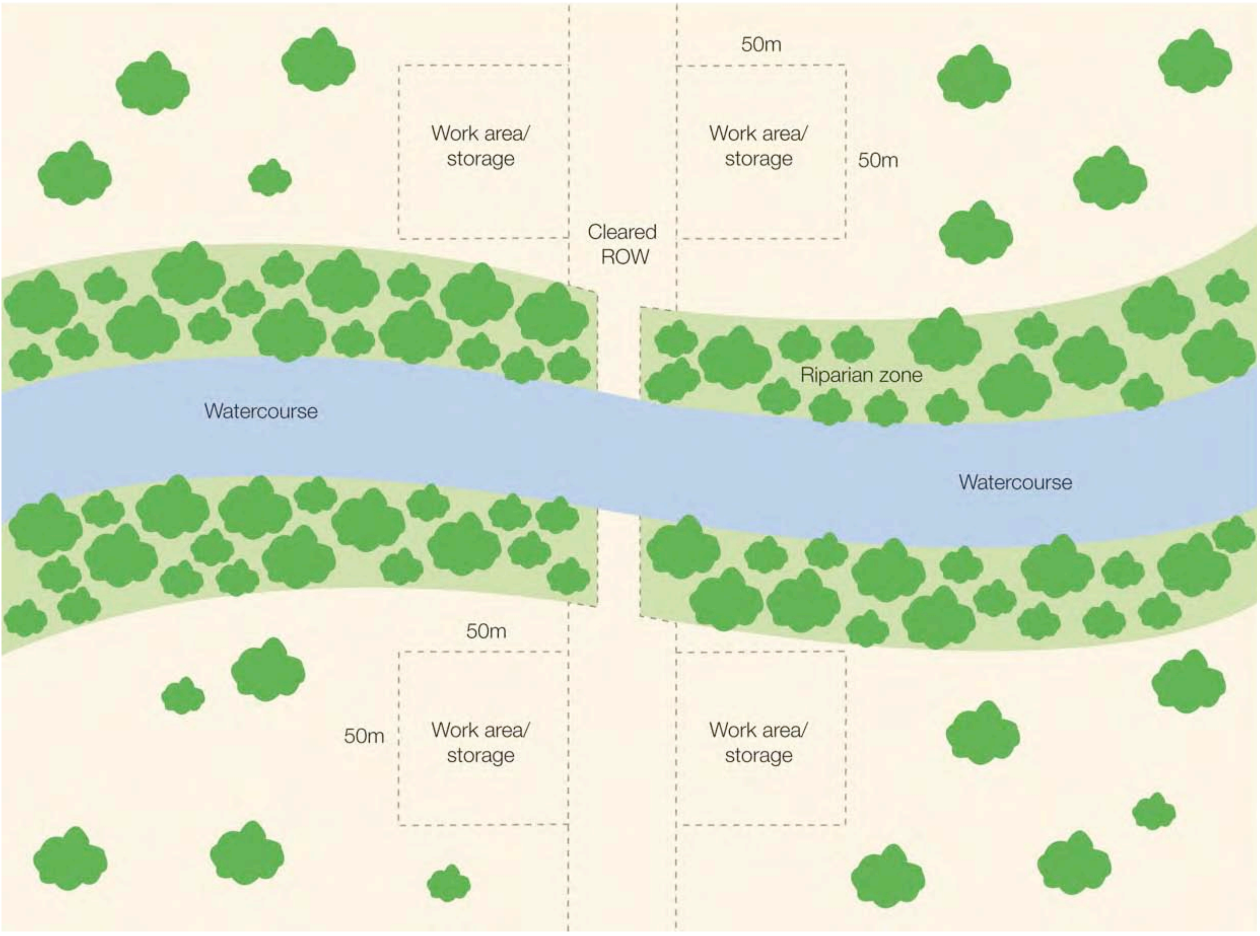
Catchment Management Authority	Water feature	ID number	KP
Border Rivers – Gwydir CMA	Barwon River	SW1	222
Border Rivers – Gwydir CMA	Gnoura Creek	SW3	231.5
Border Rivers – Gwydir CMA	Boomi River	SW5	235
Border Rivers – Gwydir CMA	Whalan Creek	SW8	252
Border Rivers – Gwydir CMA	Gil Gil Creek	SW9	287
Border Rivers – Gwydir CMA	Marshalls Ponds Creek.	SW10	316.5
Border Rivers – Gwydir CMA	Gwydir River	SW12	332
Border Rivers – Gwydir CMA	Mehi River	SW16	339
Border Rivers – Gwydir CMA	Tycannah Creek	SW20	357
Border Rivers – Gwydir CMA	Gurley Creek	SW22	366
Border Rivers – Gwydir CMA	Ten Mile Creek	SW34	404
Namoi CMA	Namoi River	SW54, SW66, SW67, SW68, SW76	445.5, 479.5, 501, 504, 527.5
Namoi CMA	Mooki Ck	SW83, SW84, SW85	556.5, 559, 566
Namoi CMA	Quipolly Ck	SW90	591.5
Hunter-Central Rivers CMA	Petwyn Valley Creek	SW117	658.5
Hunter-Central Rivers CMA	Kingdon Ponds	SW126	688
Hunter-Central Rivers CMA	Hunter River	SW127, SW167, SW168, SW173,	694, 780.5, 783, 800.5
Hunter-Central Rivers CMA	Fal Brook Creek	SW148	738.5
Hunter-Central Rivers CMA	Glendon Brook	SW158	756.5

Fieldwork closer to the time and place of actual construction would examine aspects such as the:

- Crossing methodology.
- Site-specific mitigation/management measures.
- Extent of riparian vegetation clearing.
- Working area within the ROW. The ROW is often narrowed within the riparian zone and work/storage areas are established further away from the watercourse, as shown in Figure 15.1.
- Avoidance of unstable and/or steep incised banks.
- Path of the watercourse to avoid:
    - Crossings at bends in the channel and the confluence with other channels.
    - Crossings over 'meandering' waterways, or where such meandering is likely to occur in the future (such as in flood events). Mitigation measures would give consideration to damage to the pipeline, erosion of the waterway channel, or the future misalignment of the channel with the pipeline crossing. If crossings over meandering waterways cannot be avoided, consideration shall be given to the use of weight coating or extra depth of cover over the extent of the area where alterations are predicted to occur.
- Avoidance of semi-permanent waterholes.
- Avoidance of rock basement or rock outcrops.
- Environmental flow requirements to maintain healthy river function.
- Impacts on sensitive downstream receptors, such as the Hunter Estuary. Impacts assessment would relate to a more detailed understanding of temporary changes to water quality (from increased turbidity) and flow regimes. Site-specific mitigation measures would be developed to ameliorate impacts and may include water quality and flow monitoring.

The requirements of CMAs and other statutory authorities, such as the DPI (Fisheries), DECC and DWE would be a key consideration and ongoing consultation with these agencies is a key component in ensuring this input. The DPI, DECC and DWE would also be provided with the selected 'as built' crossing profile.

Figure 15.1 Minimised ROW within riparian zone



15.5.2 Timing of fieldwork and consultations

In selecting an appropriate pipeline watercourse crossing method, many factors must be taken into consideration. These include (but are not limited to):

- Pipeline diameter.
- Watercourse width, depth and flow.
- Environmental sensitivity.
- Geotechnical concerns, including bank slope and stability.
- Substrate composition.
- Hydrological data.
- Cost.
- Navigation.
- Need for access across watercourse during construction.
- Regulatory constraints.
- Downstream water users.

- Landowner and community issues.
- Engineering constraints (eg buoyancy, bending radius).
- Timing (ie season).
- Amount of working space.

Due to the variability of site and seasonal conditions, particularly flow regimes of a watercourse at the time and place of construction, the appropriate watercourse crossing techniques would be determined closer to the time of construction. This approach is considered to be the most relevant for minimisation of environmental impacts to those watercourse crossings identified as having potentially high sensitivity (refer to Table 15.3).

The proponent would engage with DECC, DPI and DWE with regards to crossing methods and site specific management measures for high sensitivity watercourse crossings.

16 Infrastructure

This section addresses the interactions of the proposed pipeline with other infrastructure including roads, rail and utility infrastructure. The assessment methodology is explained, existing infrastructure locations are identified and the potential impacts and mitigation measures are discussed.

16.1 Assessment methodology

A tiered assessment methodology for infrastructure was undertaken, taking into consideration the mitigation measures that are inherent within standard pipeline construction procedures. The tiered process for assessing infrastructure impacts considered those impacts that:

- Could be managed through standardised mitigation measures, such as in the detailed design phase.
- Constituted the need to undertake an area specific assessment based on a range of potential complex variable impacts.

Potential impacts on infrastructure have been assessed by identifying the infrastructure that would be crossed or affected by the proposal, consulting the relevant stakeholders to determine their requirements and developing the design accordingly. The Study Area has been selected to minimise the number of crossings required and crossing methods have been developed with the aim of minimising potential impacts on the infrastructure. Reference should also be made to Chapter 3 and Chapter 6.

Potential impacts would be managed in subsequent phases of the proposal through further consultation with relevant infrastructure owners and managers to identify their approval requirements. These requirements would be incorporated in the design and standard work methods of the proposal.

16.2 Existing infrastructure

Infrastructure potentially impacted by the proposed pipeline includes roads, railways, electricity transmission lines and other pipelines. The Study Area also passes within 500m of Narrabri Airport. Major infrastructure that would be potentially affected by the pipeline is listed in Table 16.1. Other infrastructure to be crossed such as water and sewer lines, telephone and fibre optic cables would be identified through services searches (eg ‘Dial Before You Dig’) during detailed design. Chapter 5 (Proposal description) provides further details on the construction activities relating to QHGP. Reference should also be made to Chapter 11 in relation to proposed crossing methods and management measures relating to road crossings. Figures contained within Chapter 4 show the major infrastructure within the vicinity of the Study Area.

Table 16.1 Potentially affected infrastructure

Name	Approximate KP	Probable construction method
Roads and Traffic Authority roads (classified roads)		
Pacific Highway (Principal Road)	813	Horizontal bore or HDD crossing, possibly combined road and waterway crossing.
Oxley Highway (Principal Road)	531	Horizontal bore.
Newell Highway (Principal Road)	332	Horizontal bore or HDD crossing, possibly combined road and Moree Weemelah railway crossing.
New England Highway (Principal Road)	635, 636, 691	Horizontal bore or HDD crossing, possibly combined road and waterway crossing.
Kamilaroi Highway (Principal Road)	451, 452, 474.5, 477.5, 590.5	Horizontal bore or HDD.
Gywdir Highway (Principal Road)	340	Horizontal bore or HDD crossing, possibly combined road, waterway and abandoned railway crossing.
Gresford Road (Secondary Road)	758	Horizontal bore or HDD crossing, possibly combined road and waterway crossing.
Carnavon Highway (Principal Road)	289, 306.5	Horizontal bore or HDD crossing.
Other roads (not classified)		
Caloona Boomi Road (Secondary Road)	243–244	Trench excavation. Partial road closure.
Millie Bellata Road (Secondary Road)	390	Trench excavation. Partial road closure.
Narrabri Bingarra Road (Secondary Road)	430	Horizontal bore.
Quirindi Premer Road (Secondary Road)	593	Horizontal bore or HDD crossing, possibly combined road and waterway crossing.
Scone Road (Secondary Road)	677	Horizontal bore.
Tocal Road (Secondary Road)	792	Horizontal bore or HDD crossing, possibly combined road and North Coast railway crossing.
Clarence Town/Paterson Road (Secondary Road)	795	Horizontal bore.
Morpeth Road (Secondary Road)	800	Horizontal bore or HDD crossing, possibly combined road and waterway crossing.
Raymond Terrace Road (Secondary Road)	806	Horizontal bore.
Tomago Road (Secondary Road)	815	Horizontal bore or HDD crossing, possibly combined road and waterway crossing.

Name	Approximate KP	Probable construction method
Approximately 100 minor roads including unsealed roads	Various	Trench excavation. Partial road closure or full road closure with local diversions.
Railway lines		
Werris Creek Moree	579.5	Horizontal bore.
Binnaway Werris Creek	583	Horizontal bore.
North Coast	792	Horizontal bore or HDD crossing possibly combined rail and road crossings.
Moree Weemelah	289, 297–299, 308–313, 321, 333	Horizontal bore or HDD crossing, possibly combined road, rail and waterway crossings.
Main North line	634, 638.5, 691	Horizontal bore or HDD crossing, possibly combined road, rail and waterway crossings.
Newcastle / Kooragang Island	820, 825	Horizontal bore or HDD crossing.
Abandoned line	340.5	Horizontal bore or HDD crossing, possibly combined road, rail and waterway crossings.
Airports		
Narrabri	0.5km to Study Area	No crossing required. Route alignment has avoided airport property boundary.
Landing ground near Rutherford	Less than 800m to Study Area	No crossing required. Route alignment has avoided airport property boundary.
Powerlines		
	341	Open trenching.
	439	Open trenching.
	439	Open trenching.
	454.5	Open trenching.
	525.5	Open trenching.
	640	Open trenching.
	658.5	Open trenching.
	699–700	Open trenching.
	703	Open trenching.
	709.5	Open trenching.
	808	Open trenching.
	810	Open trenching.
	812–815	Open trenching.
	819	

Name	Approximate KP	Probable construction method
Other pipelines		
Chitchester (water)	807	To be determined during detailed design.
Sydney–Newcastle (gas)	818, 820	To be determined during detailed design.

16.3 Potential impacts

16.3.1 Construction

General impacts

Potential construction phase impacts on existing infrastructure would be:

- Delays or interruptions to services caused by accidental damage, such as hitting underground pipes or cables.
- Wear and tear of roadways resulting from construction equipment usage.
- Delays to traffic caused by temporary lane closures required to enable plant and equipment to operate for QHGP pipe laying. This may affect commuters, local communities, freight and other users. Traffic impacts are considered and assessed in Section 11.5.

Potential impacts must be considered in relation to the proposed crossing method. A summary of the proposed crossing method for each of the identified infrastructure assets is provided in Table 16.1. Each crossing design would be refined further in consultation with the relevant asset owner and/or manager during detailed design. For example, construction phase impacts on assets such as railway lines can be avoided by placing the pipeline through directional drilling or horizontal boring (refer to Chapter 5 for a description of these methods).

Taking into consideration the proposed crossing methods, and further mitigation measures as outlined below, potential impacts on infrastructure are considered to be minor, with the exception of those crossings as noted in the section below.

Area specific assessments

The likelihood for potential impacts may increase in instances where there are:

- Terrain pinch points – where infrastructure is constrained to go through a certain area. This has been noted in the vicinity of Ardglen and where the Study Area traverses over the saddle of the Liverpool Ranges at KP636. See discussion relating to the ARTC proposals for a new route within the Liverpool Ranges below.
- Future development areas – including future rural or urban residential development and alterations to existing assets (eg road duplications and rail upgrades). Potential future land use conflicts are discussed in Chapter 13.
- Multiple asset crossings – where there are rail and road intersections that are in close proximity to each other, detailed design needs to take into consideration the crossing of multiple asset features. In most instances, this would result in a combined crossing using horizontal bore or HDD (depending upon the required length and depth). This is currently evident at the Moree Weemelah Railway/Newell Highway, Binnaway Werris Creek Railway/road, Main North Rail Line/roads and North Coast Railway/Tocal Road.

The above locations are considered to be relevant, in relation to both the detailed design and consultation required. These areas have been indicated for further assessment in relation to consultation and detailed design requirements (refer to Section 16.4).

Rail proposals

The ARTC is currently considering possible new route alignments through the Liverpool Ranges around Ardglen. The purpose of a new route alignment would be to facilitate increased rail operations to accommodate forecasted coal transportation volumes in this region. New alignment proposals are focused on options relating to the reuse of the existing ARTC line and tunnel through Ardglen and multiple tunnel options. Each proposal would result in a new route across the Liverpool Ranges. These proposals would be in the vicinity of the Study Area.

Road proposals

Consultation with the RTA has identified a number of roadwork proposals that should be considered in the development of the pipeline design. The following lists RTA road alignment proposals that are in the vicinity of the QHGP proposal:

- The Boonangar Crossing Bridge will be replaced in the future. The new road alignment and bridge could be up to 500m upstream or downstream of the existing bridge.
- There is a proposal for future road widening at Camurra.
- There are at least three road widening and reconstruction projects along the Kamilaroi Highway corridor between Breeza and Bakana.
- The northern end of the proposed Muswellbrook by-pass is an area with bridging, fill and access requirements.
- The proposed Pacific Highway upgrades in the areas of the Branxton Link Road and the F3 to Raymond Terrace.

Consideration of the impact of the proposal on these road work proposals during detailed design, in consultation with the RTA, would allow potential impacts on future road alignments to be avoided. Refer to Section 16.4 below.

16.3.2 Operation

Potential impacts during operation of the pipeline would be limited to those caused during maintenance activities within other infrastructure service corridors. There is potential for disturbance to the safety and integrity of the pipeline due to interference by other utility providers. These incidents are considered as potential hazards to the pipeline, and have been reviewed and assessed in Chapter 14.

The other potential operational impacts relate to damage to the pipeline itself caused by AC induction where the pipeline is parallel to high voltage overhead powerlines. This can happen in instances where overhead transmission power lines can induce a current in the material of the pipeline. Steel is itself a conductor of electricity. The risks associated with this are discussed in Chapter 14.

16.4 Proposed mitigation measures

16.4.1 Detailed design phase

Continuing consultation with third party infrastructure owners and the detailed pipeline alignment and design phase will provide inherent protection measures. These are discussed below.

Consultation

Measures to protect third party infrastructure would be developed through consultation with the relevant asset owners and managers during detailed design and delivery phases to determine their requirements for crossings and works generally in the vicinity of their asset. It is appreciated that the asset owner has the expertise and is best placed to understand how the risks and impacts to their infrastructure might be minimised. Therefore, a stakeholder engagement strategy has been put in place to ensure all asset requirements are included in the proposal design and implemented in the delivery (construction and operation) phases.

Initial consultation with the relevant infrastructure bodies has commenced (refer to Chapter 6) and the initial mitigation measures identified are summarised in Section 16.4.2. These would be further developed through on going consultation during the detailed design phase of the proposal.

The infrastructure stakeholders identified and consulted were (refer to Chapter 6):

- ARTC.
- Country Energy.
- Hunter Water.
- Central Ranges Pipeline Pty Ltd.
- Energy Australia.
- Transgrid.
- Eastern Star Gas Limited.
- Macquarie Generation.
- RTA.
- Telstra.

Further, in areas of known potential land development, additional safeguards such as heavy wall pipe will be implemented to strengthen safeguards to the pipeline. Reference should be made to Chapter 13 for potential land use issues.

All potential stakeholder engagement issues have been noted through the stakeholder consultation undertaken at for the EA. Potential further investigations/consultation areas have been noted as areas requiring further assessment.

Finalised route alignment

Potential impacts on infrastructure would be managed to ensure that there is either no disruption to the associated service (in the case of rail, electricity and telecommunications transmission, airports and other pipelines), or minimal disruptions (in the case of roads). This would be achieved initially through careful route selection (refer to Chapter 3) and in the detailed design phase. The Study Area has minimised the:

- Number of major infrastructure crossings required.

- Use of certain existing easements, particularly road easements, to maximise the long term security of the pipeline.

Engineering design

During detailed design, services searches would be undertaken to identify the exact service crossing requirements. All legal and other requirements for works either crossing or in the vicinity of other services would be identified during the detailed design and delivery phases of the proposal. These requirements would be met during construction and operation. The detailed design phase would determine the depths and alignments of utilities and services. Engineering design solutions would be developed for any crossings of utilities and services.

Hazards and risks would also be addressed during the detailed design phase, considering, for example, the impact of utilities on the proposed pipeline, such as *AS/NZS 4853:2000 Electrical Hazards on Metallic Pipelines*. Refer to Chapter 14 for the preliminary hazards and risks assessment.

16.4.2 Construction

In addition to these inherent protections in the detailed pipeline alignment and design, there are general and specific mitigation measures that would be implemented during construction.

General mitigation measures

A range of general measures would manage adverse impacts as a result of accidental damage to third party infrastructure, utilities and services. These are outlined in Table 16.2.

Table 16.2 General mitigation and management measures during construction

Potential impact	Mitigation measures
Impacts to third party infrastructure	• The location of existing third party infrastructure in the ROW would be accurately identified on the alignment sheets and physically marked on the ground prior to trenching activities. • Stakeholder engagement with infrastructure owners/managers would continue to ensure their requirements for crossings and works in the general vicinity of their infrastructure are implemented during construction and operation.
Impacts on multiple infrastructure	• A collaborative management approach involving the relevant infrastructure owner/managers would be ongoing to coordinate measures in areas where multiple infrastructure and services are potentially affected.
Disruption to major roads	• All major sealed road crossings would be bored to minimise impacts. • Traffic management measures would be implemented to ensure no major roads are permanently impassable. Refer to Chapter 11 and Section 11.5 for traffic and transport assessment of impacts.
Disruption to rail	• All rail crossings would be bored to ensure there would be no interruption to rail traffic although some reduction in speed may be required, in accordance with rail authority procedures.
Impacts to other utilities and services	• The locations of surface and underground communication, water, wastewater and irrigation infrastructure would be identified and appropriate protection measures applied. • All known infrastructure would then be marked on alignment drawings and identified in the field to enable the construction crew to avoid the potential for infrastructure damage.

Potential impact	Mitigation measures
Accidental damage	• A Construction Safety Management Plan would be developed and would include project safety management processes, preventative actions and specific safe work practices for works in the vicinity of other infrastructure and services. • An incident management plan would be developed for the project outlining processes for managing any accidental damage.

Specific mitigation measures

The specific initial requirements of utility providers, as indicated from stakeholder consultation undertaken as part of this EA, have been obtained. These would be implemented and are outlined in Table 16.3.

Table 16.3 Specific stakeholder initial mitigation and management measures during construction

Potential impact	Mitigation measures
Adverse impacts on Transgrid's easement	• All works within Transgrid's easements would comply with the *WorkCover Code of Practice (2006) for Work Near Overhead Powerlines, catalogue No. 1394*. • Vehicle or plant equipment that could exceed 4.5m in height would not be permitted in the easement except when operating under the procedures outlined in the *WorkCover Code of Practice (2006) for Work Near Overhead Powerlines, catalogue No. 1394*. • No excavation would occur within 15m of any Transgrid structure and any excavation within the easement would be fenced. • A continuous and unobstructed access way along the entire length of the Transgrid easement would be maintained at all times. • Works would not permanently alter the existing ground level within the easement. • Dust would be controlled to prevent impact on the insulators.
Adverse impacts on road crossings	• All crossings of roads on the classified roads network would be conducted in accordance with roads works licences obtained as required by the *Roads Act 1993* (refer to Table 16.1). • The relevant local council would be consulted regarding requirements for crossings of roads under their control. • Pipeline crossing under sealed main roads would be conducted using mechanical under boring techniques rather than hydraulic methods. • All pipeline crossings would be located as perpendicular to the road as possible. • Pipeline crossings would have a minimum cover of 1.2m under the road formation and 0.9m cover elsewhere within the road reserve, including the bottom of any drain. • Permanent markers would be provided at the entry and exit points of the road reserve.
Adverse impacts on rail crossings	• Detailed design plans for each railway crossing would be submitted to the line owner/manager. • Application for location of the pipeline within any railway corridor would be made to the relevant owner/manager and any resulting approval requirements or conditions would be met.
Adverse impacts on	• The owners /operators of the Narrabri Airport and the landing ground near Rutherford would be consulted to identify requirements for works in the vicinity

Potential impact	Mitigation measures
airports	of the airports and these requirements would be met.

16.4.3 Operation

A range of management and mitigation measures would be implemented during operation to protect the integrity of the QHGP pipeline and to ensure protection of the pipeline easement from future development that may impinge on the alignment (refer to Table 16.4). Further measures would be implemented to prevent damage to infrastructure, utilities and services in the vicinity during pipeline maintenance and conversely to protect the pipeline during infrastructure and utilities maintenance.

Table 16.4 Mitigation and management measures during operation

Potential impact	Mitigation measures
Impingement on pipeline integrity and easement	• QHGP easement would be registered with NSW Department of Lands. • Alignment would be notified to utility search providers such as ‘Dial Before You Dig’. • Consultation with landowners to maintain integrity of pipeline easement and access arrangements.
Impacts on infrastructure, utilities and services during pipeline maintenance	• A cooperative management approach would be developed with the provider of the utility or infrastructure that is interacted with (traversed or with an easement over) by the QHGP. This would address pipeline maintenance and access arrangements and conversely maintenance works on existing utilities and services in proximity to the QHGP. • Maintenance access points or valves will be located outside the road reserve wherever possible.
AC induction	• Potential long-term impacts arising from AC induction in the vicinity of high voltage overhead powerlines would be taken into account during detailed design. • Compliance to AS/NZS • AC induction modelling and providing additional CP of the pipeline where required.

17 Other issues

This chapter reviews other issues, as defined from the environmental risk analysis presented in Chapter 8. Other environmental issues have been assessed and frameworks for the management and mitigation of potential impacts have been detailed. These issues are routinely experienced during pipeline construction and can be mitigated by standard best practice measures.

17.1 Resource and waste management

This section examines waste management from a whole of pipeline perspective. Principal waste streams from the construction and operation of the pipeline have been identified and management measures discussed.

It is noted that this section also examines resource management, including water and energy use during construction and hydrostatic test water for use during commissioning of the pipeline prior to operation.

This section does not provide details on the management of fuels, oils and contaminated land (refer to Section 17.2). For further detail about impacts of waste on biodiversity (Chapter 9), human amenity (Chapter 11) and surface and groundwater (Chapter 15) please refer to the relevant sections.

17.1.1 Waste guidelines

The *Protection of the Environment Operations Act 1997* (PoEO Act) primarily comes into force when an activity has been identified as a 'Scheduled Activity' as listed in Schedule 1 to the PoEO Act. There are no scheduled activities, in relation to waste generating activities, for the construction and operation of the proposed pipeline.

The *Waste Avoidance and Recovery Act 2001* (WARR Act) has been established, to assist in the achievement of the objectives of the PoEO Act. Under the WARR Act, the NSW Government has established the following waste management hierarchy, with the most preferable approach listed first:

- Avoidance.
- Re-use.
- Recycle (resource recovery).
- Disposal.

The Waste Classification Guidelines, produced by DECC in April 2008 provide specific guidance on classification of wastes. A waste is considered to be any discarded, rejected, unwanted, surplus or abandoned substance and it is the responsibility of the waste generator to ensure that all wastes are classified properly.

The Waste Classification Guidelines outline a number of pre-classified wastes and provide guidance on classifying waste based on chemical analysis. Chemical composition of waste varies and therefore different waste types pose differing environmental risks. Appropriate management options, transportation and disposal facilities can be explored based on the waste classification.

17.1.2 Waste classification

Each activity associated with construction and operation of the proposed pipeline would generate waste. Based on origin and composition, each waste must be classified into one of six categories as outlined in the Waste Classification Guidelines.

The six categories are:

- Special waste.
- Liquid waste.
- Hazardous waste.
- Restricted solid waste.
- General solid waste (putrescible).
- General solid waste (non-putrescible).

Waste materials arising from construction and operation of the pipeline have been identified within five of these six waste classes. Where a waste is not pre-classified or suspected of contamination, chemical assessment will be undertaken to verify classification. An outline of the principal pre-classified waste types, based on an understanding of the construction and operation activities associated with the pipeline, are provided in Table 17.1.

Table 17.1 Waste classification and waste types

Classification**	Type	Construction and/or operational activity
Special waste	Waste tyres.	• Operation of temporary facilities (maintenance facilities).
Liquid waste	Hydrostatic test waters.	• Hydro-testing.
	Concrete slurries and drilling muds, such as bentonite muds, consisting of approved water based products or synthetic lubricants.	• Infrastructure crossings (horizontal bore). • HDD.
	Liquid waste from human waste storage facilities or waste treatment, including pump-out waste and sewage.	• Operation of temporary facilities (construction camps).
	Fuels, engine coolant.	• Operation of temporary facilities (maintenance facilities).
Hazardous waste	Lead-based paint waste (pre-classified by the EPA).	• Operation of temporary facilities (construction camps and maintenance facilities). • Construction of ancillary pipeline facilities.
	Lead-acid or nickel-cadmium batteries (pre-classified by the EPA).	• Operation of temporary facilities (maintenance facilities). • Pipe stringing and bending, pipe welding and inspection.

Classification**	Type	Construction and/or operational activity
	Gasket adhesives, cutting lubricants, cleaning agents, water treatment chemicals, and non-destructive testing (spent pipeline x-ray film), fusion bonded epoxy (FBE) powder or other plastic material.	• Operation of temporary facilities (maintenance facilities). • Pipe stringing and bending, pipe welding and inspection.
	Any other waste material that meets the criteria for dangerous goods under the *Australian Code for the Transport of Dangerous Goods by Road and Rail.*	• Operation of temporary facilities (construction camps). • Pipe stringing and bending, pipe welding and inspection. • Construction of ancillary pipeline facilities.
General solid waste (putrescible)	Non recyclables.	• Operation of temporary facilities (construction camps).
	Any other general solid waste that meets step six of the classification guidelines.	• Operation of temporary facilities (construction camps) • Pipe stringing and bending, pipe welding and inspection. • Construction of ancillary pipeline facilities.
General solid waste (non-putrescible)	Recyclables – Glass, Aluminium cans, PET plastic bottles, welding rods, circumferential fibre/nylon rope spacers used in pipe transport, scrap metal and off cuts, paper and cardboard.	• Operation and decommissioning of temporary facilities (construction camps). • Pipe delivery, stringing and bending, pipe welding and inspection. • Construction of ancillary pipeline facilities. • Repairs.
	Concrete, metallic materials, brick, rubble, soils (top soil, fill materials), rock escarpment (sheet rubble).	• Operation and decommissioning of temporary facilities (construction camps). • Clear and grade of the ROW. • Trenching. • Blasting. • Pipe stringing and bending, pipe welding and inspection. • Backfilling and compaction. • Construction of ancillary pipeline facilities. • Reinstatement and maintenance.
	Garnet for grit blasting welded joints.	• Operation of temporary facilities (maintenance facilities). • Pipe welding and inspection.
	Vegetation (including grasses, established trees and shrubs), fencing.	• Set up of temporary facilities (construction camps). • Clear and grade of the ROW. • Construction of ancillary pipeline facilities. • Reinstatement and maintenance.
	Drained and crushed oil filters, and rags, oil absorbent materials that do not contain free liquids.	• Operation of temporary facilities (maintenance facilities).

Classification**	Type	Construction and/or operational activity
	General debris material within pipe.	• Pipe cleaning and inspection.
	General store yard rubbish (example drums, synthetic material fibres).	• Operation of temporary facilities (construction camps and maintenance facilities). • Construction of ancillary pipeline facilities.

*** Wastes classified in accordance with six steps of the Waste Classification Guidelines, Part 1: Classifying Waste, DECC NSW, April 2008.*

There should be minimal spoil waste removal from the site. Spoil from the trenching operations would be reused through a specialised padding machine to sift soils so that they are suitable for laying the pipe on. Any residual spoil material would be spread across the ROW, creating a berm effect that would flatten over time. Similarly, vegetation (including grasses, established trees and shrubs) from ground clearing works will not be transported off site but will be stockpiled and respread during reinstatement works.

17.1.3 Potential impacts

Construction waste

The nature and volume of waste generated during the construction of the proposed pipeline, if not managed appropriately, may potentially impact on:

- Visual amenity and aesthetic quality of the construction area that is located within a predominantly rural area.
- Water quality of local drainage lines and watercourses. This is particularly relevant for gross pollutants (litter) that may become wind borne and enter any watercourses during crossing constructions.
- Health and safety of workers and visitors to the site.

Resource use

Water

The main use of water on site, during construction, would be for:

- Hydrostatic testing procedures.
- Dust suppression.
- Potable water supply for drinking.
- Potable water supply for other use in construction camps.

Potential impacts from the hydrostatic water testing of the pipeline are related to the extraction and discharge of test water from existing water sources and may include:

- Temporary depletion of water resources due to water extraction.
- Erosion at site of hydro-test water discharge.
- Receiving water quality impact if hydro-test water is discharged directly to a watercourse causing potential changes to water quality (eg increase levels of turbidity at discharge point).

Dust suppression would be used as part of air quality mitigation and management measures (refer to Section 11.4). In general, water used for dust suppression would be brought onto site using water carts. The amount of water used is dependant on the length of the ROW during construction and the soil types (dusty, rocky). In areas where existing roads can be used, the ROW access road would be shorter. Water carts generally carry around 20m^3 of water per truck. Based on a spread of 70km ROW (the maximum length assumed as part of this assessment), it is estimated that up to 500m^3 of water would be used for dust suppression per day.

Potential impacts from water use on site for dust suppression would be related to the sourcing of water and the potential for temporary depletion of water resources due to water use requirements. Soil and erosion control issues are addressed in Chapter 15.

Energy

Energy use on site is required to power plant and equipment, communications, and amenities at the construction camp. Due to the remoteness and transient siting of construction camps and activities, energy use would be sourced on site (diesel) or through the use of solar energy.

There would be a no fire policy established on site for health and safety reasons. As such, there would be no burning of fuels (vegetation or other wastes) on or near the ROW.

17.1.4 Proposed mitigation and management measures

Principles of waste management

In general, waste streams would need to be managed throughout the duration of the project to satisfy the following main aims:

- Waste management strategies would be developed in accordance with the WARR Act and by adopting the resource management hierarchy principals (in order of priority) of avoidance, resource recovery and disposal.
- Waste to be disposed of off site would be disposed of to a waste facility that is licensed under the PoEO Act to receive wastes of that type.

These principles would be embodied in the CEMP. The CEMP would be prepared prior to the initiation of construction activities and would include the following:

- Procedures to classify all waste types in accordance with the Waste Guidelines and NSW legislative requirements.
- Actions to quantify and classify excess excavated material after backfill, if any.
- Resource recovery and reuse strategies for each type of material where applicable.
- Details of how waste would be stored and treated on site.
- Procedures and disposal arrangements for all material according to waste classification.
- Reporting and recording requirements for all waste movements, allowing determination of recycling and reuse levels achieved (landfill diversion).

Classified waste management

Table 17.2 outlines specific management measures that would be implemented for classified wastes, as defined in the Waste Guidelines.

Table 17.2 Waste mitigation and management measures during construction

Waste type	Management measures
Special waste	Waste types must be tracked when transported interstate but not when transported within NSW.
Hazardous waste	Handling, storage and transport of hazardous materials and waste would be in accordance with the *National Code of Practice* and the relevant material safety data sheet (MSDS) for the product.
	Any hazardous waste associated with project activities would be separated from non hazardous waste. If small amounts of hazardous waste are mixed with non hazardous waste the entire quantity of waste would be treated as hazardous.
	Reporting protocols to ensure that any hazardous and liquid wastes are tracked from 'cradle to grave'.
	Any waste identified as hazardous or liquid waste in accordance with the Waste Guidelines, would be transported by an authorised contractor. A written agreement must be in place prior to the commencement of this type of waste disposal.
	Sewage and sullage disposal would be via appropriate septic systems, mobile chemical treatment system or approved contractor.
General solid waste (putrescible)	All putrescible solid waste generated would be stored in labelled waste containers and isolated from surface water drains. Waste would be removed at regular intervals and disposed of, as required, at an approved waste facility.
General solid waste (non-putrescible)	Cleared vegetation or other material would be stored at the edge of the easement and respread over the ROW to reduce erosion and promote revegetation.
	Recyclable waste would be kept separate from other waste and stored in a designated area for future disposal at an appropriate recycling facility, if practicable.

Resource management

Table 17.3 outlines the management principles that would be implemented in relation to water resource management during construction of the proposed pipeline. This would be mainly applicable to the construction activities associated with hydro-testing and dust suppression. Chapter 5 provides a detailed description, including water volumes, of the process for hydrostatically testing the integrity of the pipeline by filling with water and pressurising in accordance with *Australian Standard AS 2885*.

Table 17.3 Water resources mitigation and management measures during construction

Potential impact	Management measures
Temporary depletion of water resources due to water extraction.	Extraction of water would be in compliance with all regulatory and landholder requirements and would not cause environmental harm.
	A review of all water sources available would be undertaken prior to extraction for hydro-test water and/or dust suppression (dams, rivers, water supply networks). Water would be sourced from locally viable sources of least environmental impact. The exact location and quantity of water extraction would be confirmed prior to the construction activities.
	Potential impacts to other users of the water resource would be minimised by maintaining adequate flow rates and water levels and/or by coordinating water usage to minimise potential interference.
	Sensitive watercourses (high level) would not used for extraction. Chapter 15 identifies sensitive watercourses.
	Screening water uptake hose would be used.
	Where practicable, hydrostatic test water would be used for multiple test sections.
	Opportunities for hydro-test water reuse would be identified in consultation with local land owners, for example, water spraying land.
Erosion at site of water discharge.	Hydro-test and dust suppression water would be discharged to land in such a way as to prevent runoff into any watercourse or drainage lines, flooding, or erosion (eg against a splash plate or other dispersive device in order to aerate, slow and disperse the flow).
	Hydro-test water would be aerated if corrosion inhibitors were used (eg by spraying).
	Discharge points for soil erosion and surface water sedimentation runoff would be inspected.
Changes to water quality of receiving water environ, which may lead to a pollution incident.	Hydro-test water would not be directly discharged to watercourses.
	The use of environmentally harmful chemical additives in the hydro-test water, such as corrosion inhibitors and biocides, shall be avoided, where practicable. If chemical additives are used, they will be selected to be biodegradable.

These principles would be included in a specific section on water resource management and would form part of the CEMP.

17.2 Contaminated land

17.2.1 Introduction

A contaminated land assessment report has been prepared by Heggies and is attached in Appendix L. This report investigated the contaminated land data readily available at the time of preparation. It is anticipated that as part of the consultation process, information would be made available by local councils and other relevant authorities regarding other contaminated lands. It is also anticipated that some contaminated land issues will not be able to be foreseen and that a process would be implemented to address this potential during construction.

17.2.2 Existing environment

A preliminary investigation of the regions and the Study Area has been undertaken (refer to Appendix L). Due to intensive land use that has occurred in many areas in NSW, soil and water contamination may exist in the Study Area. This may include contamination with anthropogenic chemicals (eg fuels, oils, pesticides, herbicides, asbestos, metal compounds and waste products) that may be organic or inorganic in form, or the accumulation of excessive natural products, such as heavy metals contained in fertilisers, resulting from human management. Depending on the nature and concentration of contaminants, soil and groundwater contamination may have potential health and environmental impacts that could affect the QHGP proposal.

Registered contaminated sites

The DECC maintains a register of contaminated lands, under the provisions of the *Contaminated Land Management Act 1997* (CLM Act). A total of 24 such sites were identified within and around the Study Area. Three of these sites (refer to Figure 17.1), which are all within the Newcastle region, are located close to or partially within the Study Area and are noted in Table 17.4.

Table 17.4 Registered contaminated sites within the Study Area (CLM Act**)**

No.*	Address	Site name	Potential contaminants	Region	KP
8	Cormorant Rd, Kooragang	BHP Kooragang	'Asbestos disposal area'.	Newcastle	819 to 824
9	15 Greenleaf Rd, Kooragang	Orica – Kooragang Island	Particularly groundwater contamination – arsenic, total ammonia and nitrate.	Newcastle	824 to 825
24	School Dr, Tomago	Genkem Pty Ltd	Lead and chromium in the soils and groundwater at the site and surrounding area.	Newcastle	815 to 816

Note: Site numbers referred to in report contained in Appendix L and shown in Figure 17.1.

The extent of contamination identified at the above noted sites and the potential impact on QHGP would be assessed at the detailed design phase. It is important to liase with stakeholders and landholders to confirm and determine the extent of contamination.

Drawing no. 07002g_CP_C_01-1

Date 02 September 2008

Source Geoscience Australia
Heggies Pty Ltd
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Airport/Landing ground
- NSW estate
- Recreation area
- Built up area
- LGA boundary
- Major road (Hwy/Fwy)
- Principal road
- Secondary road
- Minor road
- Minor road (unsealed)
- Railway
- Major river (perennial)
- Minor river (non-perennial)
- Registered contaminated site proximate to the study area
- Other registered contaminated site

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 17.1 Registered contaminated sites within the Newcastle region

Potential contaminated sites

There is potential for contaminated sites that are not currently registered with the DECC to be located near or within the Study Area. These would be identified during the ongoing route selection and consultation processes. For example, the Walfertan tannery, located near Aberdeen (KP687), has been identified as a potential contaminated site during field assessments carried out as part of the route selection process. This, and any other potential contaminated sites that are identified, would be investigated at the detailed design phase and included in the CEMP.

17.2.3 Potential impacts

Construction

Trenching and grading activities that disturb contaminated lands are likely to adversely impact the surrounding environment if not managed appropriately. In addition, construction activities may lead to the contamination of land as a result of chemical, oil or other material spills or leaks. Potential impacts that may result from the proposal include:

- Disturbance of contaminated land as a result of clearing or trenching activities during the construction period, affecting the local environment.
- Human health impacts resulting from the disturbance of contaminated lands.
- Contamination of land or soils due to spills such as chemicals and oils, resulting in pollution and environmental damage.

Operation

There is limited potential for contamination during operation. Maintenance procedures may incur a risk of potential contamination of soils due to spills such as pig trap contents, chemicals and oils. Risks associated with the operation of the pipeline are examined in hazards and risks assessment (refer to Chapter 14).

17.2.4 Proposed mitigation and management measures

Route selection has been informed by avoidance of known contaminated sites through searches of registers and consultation with landowners. However, should contaminated land be encountered during excavation activities associated with pipeline construction, a range of mitigation options is available to manage potential impacts. The specific measures for dealing with contamination issues would be developed further at detailed design stage and in consultation with landholders and stakeholders taking into consideration the following:

- Site conditions, such as fill, natural soils, clay content and mineralogy.
- Groundwater characteristics, including depth, direction and flow rate.
- The nature of contaminants.
- The extent of contamination.
- Landholder and other stakeholder issues.
- Financial resources.
- Timeframe.
- Technical suitability and feasibility.
- Ongoing management.

- Operational safety and health risks.
- Ecological risks, constraints and opportunities.
- Regulatory frameworks and compliance.

The CEMP would include a detailed management approach for assessing and addressing contaminated land issues that could be encountered during the construction process. The first approach would be to avoid known contamination areas. The CEMP would also include an active register of known and potential contaminated sites. The CEMP would also outline measures to minimise the potential for contamination through accidental spills (refer to Table 17.5).

Table 17.5 Contamination mitigation and management measures during construction

Potential impact	Mitigation measures
Environmental and human health impacts resulting from excavating in contaminated sites.	• Ongoing consultation with landowners would be undertaken to identify potentially contaminated sites near or within the Study Area. • Site specific and contaminant specific management measures will be developed for any areas that are not avoidable through realignment of the route. • If potential or actual contamination is found during earthworks, work in that area will stop until a suitably qualified person has inspected the site, the hazard has been assessed and appropriate action has been taken, including delineating areas of concern as required until earthworks can resume safely. • Manage contaminated soil disposal or removal from site in accordance with DECC Waste Classification Guidelines.

Contamination resulting from accidental spills.	• Site environmental management measures would be implemented to minimise the potential for spills to occur including:
	  • Installation of bunds around chemical, fuel and other potential contaminant storage areas and at other relevant locations.
	  • Implement chemical transport, storage, handling and disposal procedures in accordance with requirements of dangerous goods and environmental legislation and industry standards.
	  • Maintenance of mobile equipment and vehicles would not be conducted within 150m of any surface water body, to reduce the risk of contamination in the event of accidental fuel or oil release.
	  • Implement spill response procedures and have spill response equipment for containment and recovery available on site.
	  • Implement remedial actions if required.
	  • Conduct workforce training.

17.3 Geology and soils

17.3.1 Introduction

Geology and soils have been assessed through a preliminary *General Soil Management Concept Phase Assessment* (refer to Appendix L). It should be noted that the soils management assessment is based on a desktop assessment only. No sampling or analysis has been undertaken. The following section outlines key issues within the report.

17.3.2 Existing environment

Soils

The following broad soil landscape provinces (refer to Figure 17.2) are expected to be encountered during the proposal:

- Darling Riverine Plain (KP222 to KP430).
- Darling Downs – Liverpool Plains (KP430 to KP635).
- Hunter – Tweed (KP635 to KP825).

Table 17.6 highlights major soil features in the existing environment.

Table 17.6 Soil landscape province characteristics

Province	Location	Major soil features
Darling Riverine Plain	KP222 to KP430	The general pattern of soils in the province is sedimentary soils that directly reflect patterns of sedimentation and today's flooding regime. Deposits of heavy dark-coloured clays dominate most of the plains. The concentration of soluble salts increases towards the south west. Solodized solonetz, which are soils dominated by sodium salts occur on most embankments raised, therefore issues in relation to salinity within the pre-existing environment of this province should be noted. Red-brown earth occurs on embankments towards the south east. Black earths are associated with plains of basaltic alluvium. In relation to the existing environment along the Study Area, between approximately KP222 and KP386 the dominant lithology affected would be coarser grained sedimentary and finer grained sedimentary. At approximately KP386 to KP396 the dominant lithology is classified as igneous (refer to Figure 17.3).
Darling Downs – Liverpool Plains	KP430 to KP635	Podzolic, solodised solonetz and solodic soils (salt rich soils) are widespread on granite, siliceous metamorphic rocks and sediments; black earth, prairie and chocolate soils (nutrient rich) with minor euchrozems and krasnozems occur on basalt. Non-calcic brown soils are of a sandy nature and are located in drier areas of this province. This type of soil includes features of moderate fertility with high to very high erosion capabilities, especially under cultivation. Red-brown earths are common in less fine-grained sediment within this province. They are generally texture contrast soils with light textured surface soil over clay subsoil. They have high erosion hazards under cultivation, with low to moderate fertility, and moderate to high waterholding capacity. Soils dominated by sodium salts are also common in the drier areas and less fine-grain sediments.

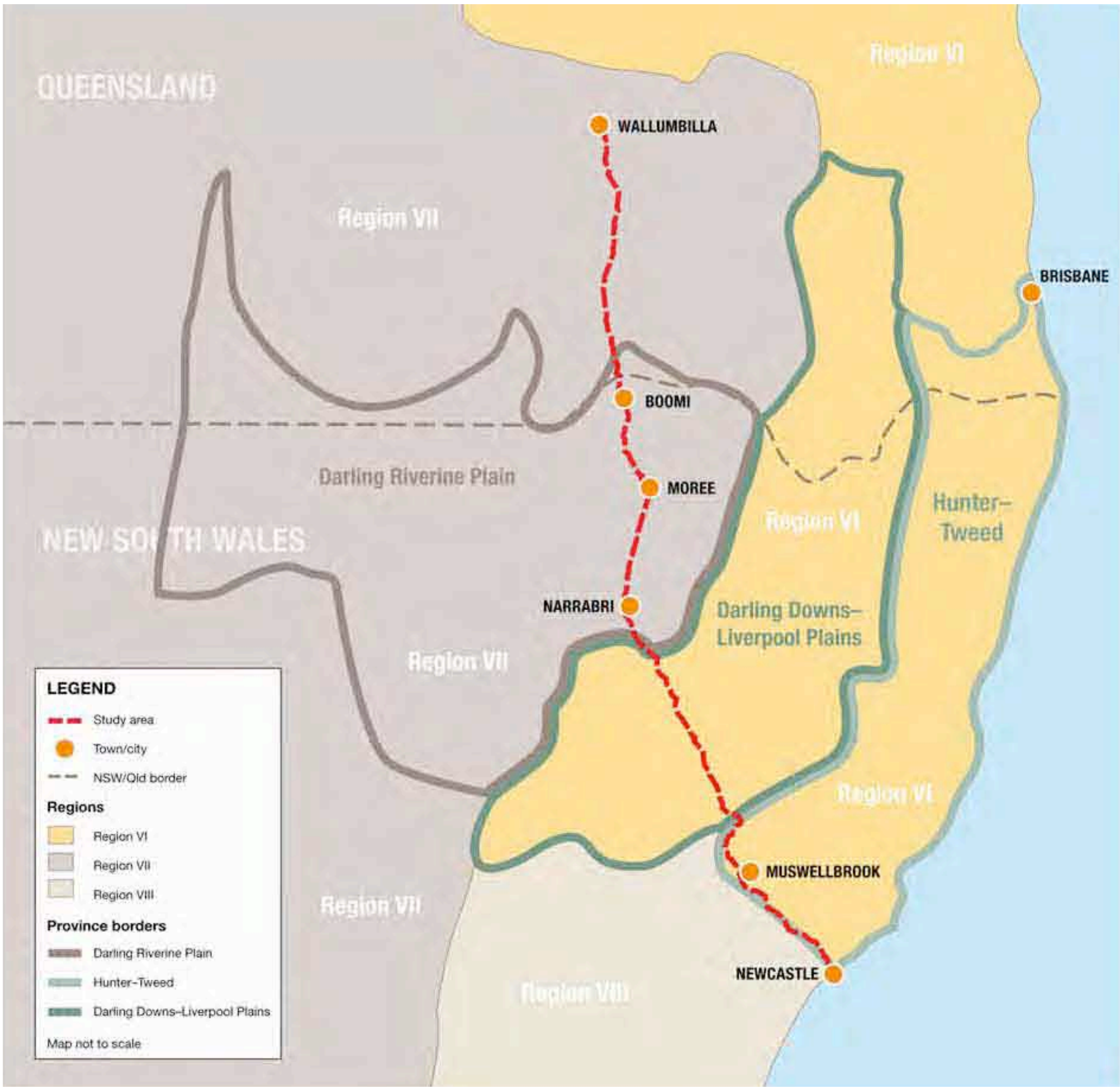
Province	Location	Major soil features
		Along the Study Area, the dominant lithology that would be affected is finer grained sedimentary and to a lesser extent coarser grained sedimentary. At approximately KP450 to KP500 and KP600 to KP635 there is the occurrence of igneous material (refer to Figure 17.4).
Hunter – Tweed	KP635 to KP825	Soils that are dominant in compounds of organic matter, aluminium and/or iron occur within this province. Soils that are typically red, deep, well-structured, acid and porous are also common in high rainfall areas (eg the Hunter region), with some black earths, red-brown earths and soils that contain soluble salts in drier sites. On the wet flood plains of the lower valleys and merging into swampy estuarine and coastal plains, humic gleys (anaerobic, moisture rich soils) including ASS are found with minor areas of acid peats and humus podzols. On the coastal dunes sedimentary soils, podzols, and some acid peats are present in wet depressions. The dominant lithology within the existing environment along the Study Area for this province is again dominated by finer and coarser grained sedimentary. However there are significant sections of the Study Area that cross into soil features that contain volcanic (approximately KP682 to KP796), coal (approximately KP635 to KP682) and igneous (approximately KP635 to KP650 and KP757 to KP796) material.

Source: Heggies 2008 – Hubble and Isbell (1983)

In addition to those general landscape groups noted above, there are a number of additional soil landscape issues known to be present within the vicinity of the proposal. These include:

- Known salinity issues likely associated with potential for locally occurring shallow water table in the Bellata area.
- A notable erosion hazard in the major farming areas on the sloping black grey clays east of the Newell Highway between Moree and Narrabri.

Figure 17.2 Soil landscape provinces



Source: Heggies, 2008

Geology

The Study Area has been selected to avoid major topographical features, large areas of volcanic derived substrate, and other aspects that would affect the constructability and cost of a pipeline. As a result, the majority of the Study Area is located on sedimentary geological units. Other geological formations within the Study Area are igneous, such as basalt, primarily located in the Liverpool Range and upper Hunter areas, as well as near Bellata and Boggabri. Table 17.7 outlines key geological and geomorphological features in the existing environment of the Study Area, whilst Figures 17.3, 17.4 and 17.5 represent the dominant lithology along the Study Area.

Table 17.7 Geological and Geomorphical features

Province	Location	Geological and Geomorphological features
Darling Riverine Plain.	KP222 to KP430	Region consists of all the plain country of the Murray-Darling River System and the enclosed hilly sections. Large sections are essentially areic (ie very low rainfall) with no systematic pattern of streams. Parallel linear dunes constitute much of the region, having a particular local orientation. These dunes are closely spaced and thinly covered with vegetation.
Darling Downs – Liverpool Plains	KP430 to KP635	Erosional uplands of Palaeozoic metamorphic and granite rocks. Mesozoic sediments and Tertiary basalts. Generally rounded hilly with some high basaltic tablelands and ranges, lower hilly plateaux and undulating colluvial to alluvial plains. Minor remnants of old land surfaces.
Hunter – Tweed	KP635 to KP825	Mountainous lands with steep escarpments on Palaeozoic sediments and granite, rolling to hilly basaltic plateaux, lower hilly areas of Mesozoic sediments, and narrow valley plains and coastal lowlands.

Source: Heggies 2008 – Hubble and Isbell, 1983

17.3.3 Potential impacts

Construction

Earthworks involved in the QHGP proposal would potentially include the excavation of soils, backfilling and area levelling, off site removal of soils, and the importation of fill. Rock breaking would be required in certain areas to achieve the specified pipeline depth. Trench spoil would be screened prior to refilling the trench around the pipeline. A review of the Study Area indicates potential impacts during construction as outlined below.

Expansive soils

Expansive soils that shrink and swell with changes in moisture content are considered to be observed in the Study Area, particularly in semi-arid and sub humid areas as can be exemplified by black, grey and brown cracking clays in northern NSW. These soils can create stability problems and during wet periods can provide difficulties for construction, particularly during trench excavation activities.

Soil erosion

Potential impacts include the erosion of soil, spoil and fill stockpiles and increased erosion potential due to disturbance of topsoil and loss of vegetation. Erosion can be from water (creating inter-rill erosion, rill and gully erosion and tunnel erosion) and wind. Soil properties affecting wind erodibility include the soil texture and moisture, and soil binding agents.

In general, when vegetation cover is disturbed or removed in areas, this will be followed by gully erosion. Saline soils areas (solodized solonetz and solodic soils) are susceptible to erosion. Table 17.6 identifies these soil types with soil landscape regions.

Rising groundwater and salinity

Rising groundwater, including shallow groundwater tables, have the potential to impact on trench stability, as water would fill into the trench.

It is generally known that irrigation areas in the Darling Plains region have difficulty managing rising groundwater levels, which consequently increases soil salinity. It is also known, through stakeholder consultation, that areas around Breeza are subject to saline conditions.

Saline soils are identified by electrical conductivity tests on either a 1:5 extract (greater than 1.5 dS/m) or a saturation extract (greater than 4.0 dS/cm). Salinity can impact on various infrastructures including:

- Waterlogging.
- Impacts on metal products used in infrastructure and on concrete materials if high sulphate levels are present.

Acid sulphate soils

The presence of ASS has been identified in the Hunter – Tweed Landscape Province, particularly between the Maitland to Newcastle areas.

ASS are formed in relatively low lying and coastal areas (eg mangrove swamps, salt marshes, and tidal lakes and estuaries) where sulphur rich materials (eg pyrite) have accumulated. When these materials are exposed to oxygen during excavation and drainage, they will generate sulphuric acid that subsequently lowers the pH value of soils, allowing metals such as aluminium and iron to be released to the environment. This may impact on the quality of waterways and can also have an affect on infrastructures made of concrete, iron and steel, which is of particular note to this proposal.

Other soil impacts

Other impacts relating to soil and geology during construction include the compaction of soils due to construction vehicles and processes, changes to soil structure and soils becoming less permeable. Soil and rock would be disturbed as a result of construction activities, particularly grading, trenching and other earthworks.

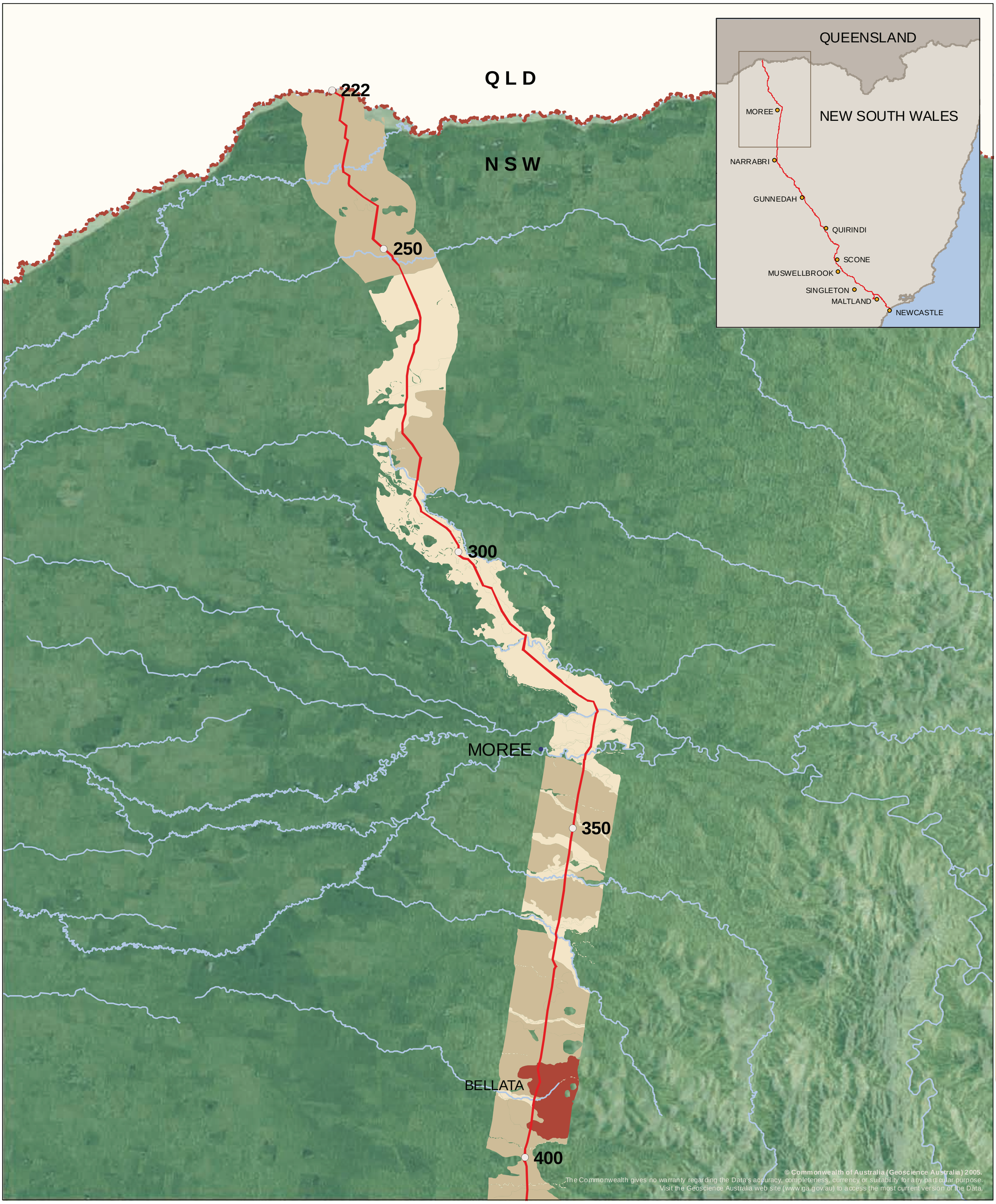
Geology impacts

Figures 17.3, 17.4 and 17.5 represent the dominant lithology along the Study Area. The Study Area has avoided locations with hard rock wherever possible; this is particularly relevant in areas surrounding Quirindi. However, the Study Area could not avoid hard rocks within the Liverpool Plains and the Darling Riverine region. It is likely that where hard rocks cannot be avoided, it may be necessary to blast the rock in these areas. Refer to Chapter 3 for further detail regarding the development of the route and Chapter 11 for potential impacts regarding noise and vibration, in relation to the blasting of hard rock.

The Study Area avoids coal sites where possible, with particular relevance to sites near Singleton. This is demonstrated during the route selection process (refer to Chapter 3). Coal mine sites are shown in Figure 3.3. It is noted, however, that the proposal passes through approximately 50km of coal related material near Scone (approx KP637 to approx 697). For further detail on the development of the route and potential impacts on land use, refer to Chapters 3 and 13 respectively.

Operation

Potential impacts on soils and geology during operation may arise from changed soil structures as a result of replacing areas of deep-rooted vegetation with shallow-rooted vegetation (shrubs and grasses) within the ROW. Ongoing compaction of the soils within the easement may also occur, through vehicle movements for pipeline monitoring and maintenance. This potential impact is unlikely to be significant however as maintenance traffic would be infrequent.



Drawing no. 07002g_CP_GS_01-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

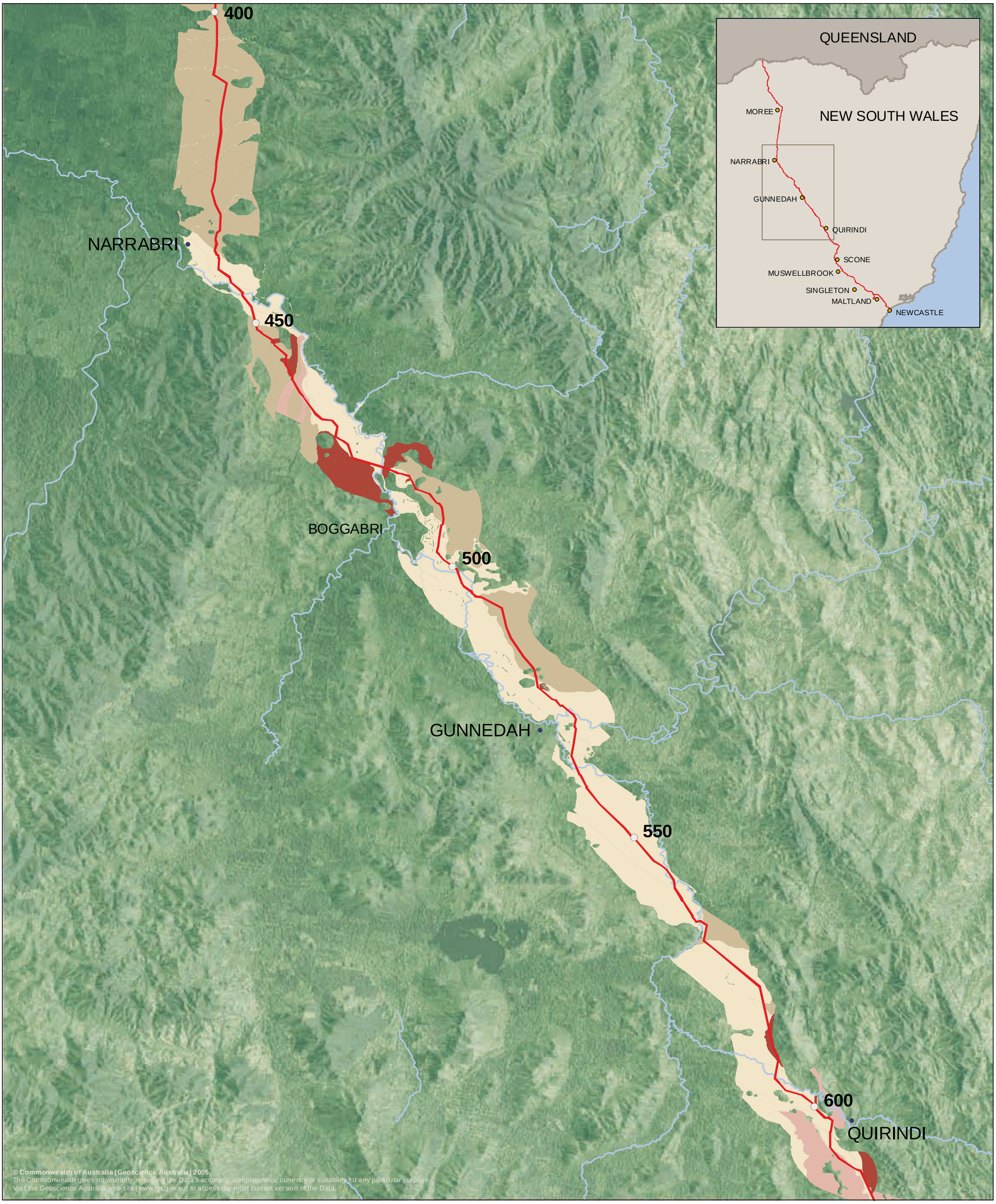
- Kilometre point
- Study Area
- Coal
- Coarser grained sedimentary
- Fine grained sedimentary
- Igneous
- Volcanic origins
- Water

Queensland Hunter Gas Pipeline

Figure 17.3 Geological features - north

1:750,000 (at A4)

0 5 10 15 20km



Drawing no. 07002g_CP_GS_02-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

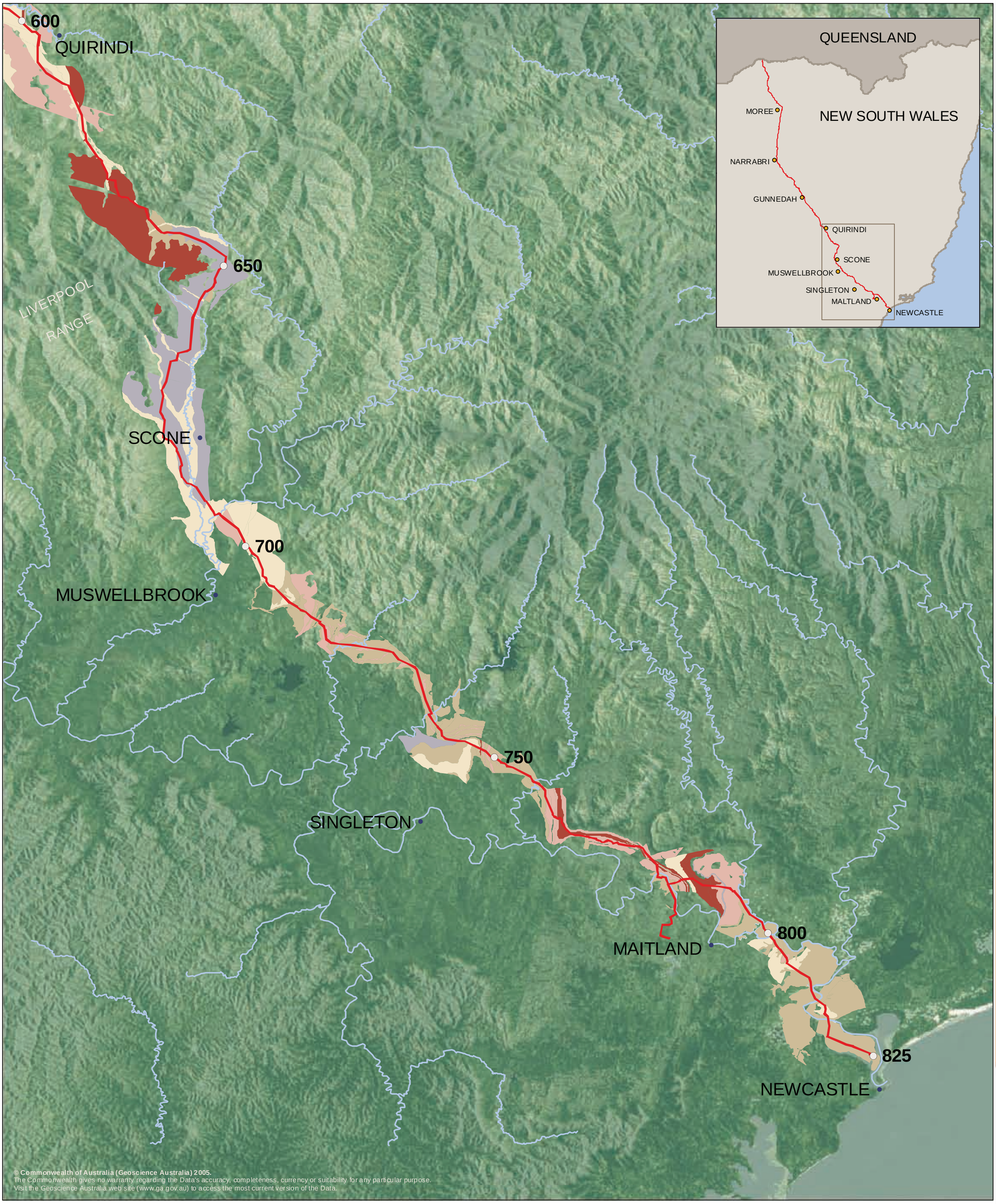
- Kilometre point
- Study Area
- Coal
- Coarser grained sedimentary
- Fine grained sedimentary
- Igneous
- Volcanic origins
- Water

Queensland Hunter Gas Pipeline

1:750,000 (at A4)

0 5 10 15 20km

Figure 17.4 Geological features - central



Drawing no. 07002g_CP_GS_03-1

Date 02 September 2008

Source Geoscience Australia
RLMS Pty Ltd

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Coal
- Coarser grained sedimentary
- Fine grained sedimentary
- Igneous
- Volcanic origins
- Water

Queensland Hunter Gas Pipeline

1:750,000 (at A4)

0 5 10 15 20km

Figure 17.5 Geological features - south

17.3.4 Proposed mitigation and management measures

A geotechnical survey would be undertaken prior to construction works commencing. This would verify soil types along the entire alignment. Management measures would be determined according to the soil type and documented in the CEMP.

Specific issues, such as acid sulphate soil management, would be addressed through the implementation of appropriate construction approaches. Chapter 5 discusses the construction methods in detail. Downstream impacts upon ecological systems are addressed within Chapter 9.

General soil and geology impacts, as a result of the proposal during construction would, in most cases be manageable through the implementation of standard mitigation and management measures as outlined in Table 17.8.

Table 17.8 Soil and geology mitigation and management measures during construction

Potential impact	Mitigation and management measures
Expansive soils	• Expansive soils would be identified and delineated along the alignment and site specific measures developed. • The depth of soils expansion would be identified and where practicable the pipe would be installed below the depth of expansive soils.

Soil erosion	• Graded soil would be stockpiled separately, so that local soils can be recovered for respreading.
	• Surface and soil stability would be maintained at all times during cut and fill excavation activities. This is also necessary from a site safety perspective and would be monitored daily.
	• Erosion and sediment control techniques would be used in construction areas, for example, berms and sedimentation fencing.
	• Topsoil respread and revegetation techniques would be used on disturbed areas to minimise erosion risks.
	• Erosion within the trench would be prevented utilising trench plugs (ie trench/sack breakers) at appropriate intervals.
	• During restoration and clean up, the following would be applied in relation to stabilisation of soils:
	  – Re-profiling of the site would be undertaken so as to achieve soil stability and congruity with the surrounding landscape.
	  – Re-seeding and the use of geo textile materials as required.
	  – Backfilling of trench in layers (example two layers) with compaction.
	  – Soil compaction would be relieved in trafficked areas (such as ripping of topsoils).
	  – Preventing site access, as far as practicable, to assist with site recovery.

Rising groundwater and salinity	• Saline soils would be identified and delineated along the alignment and site specific measures developed. • Consultation with relevant Catchment Management Authorities would be undertaken to determine the extent and appropriate management techniques for areas of known salinity. Management measures would be documented in the CEMP. • Careful topsoil and subsoil management and extra depth of cover to ensure any existing salinity is not increased. • Avoid trenching on the side of hills where possible to avoid groundwater flows.

Potential impact	Mitigation and management measures
	• Options to vegetate the ROW with saline tolerant vegetation would be investigated in consultation with DECC and landholders, where appropriate. • Dewatering of trench in areas of high groundwater. Water would be managed according to that as defined in the water resource management and mitigation measures (refer to Table 17.3).
Acid sulphate soils	• ASS would be identified and delineated along the alignment and site specific measures would be developed. • Excavated acid sulphate soil would be identified and stockpiled separately within bunding. • ASS in trench backfill would be treated with lime or a neutralising agent.
Geology impacts	• The Study Area avoids areas of coal material and hard rock wherever possible. For further detail, refer to Chapter 3 on the development of the route.

17.4 Visual amenity

This section describes the existing landscape and visual characteristics of the Study Area. It provides an assessment of the potential impacts on visual amenity as a result of the proposal during both the construction and operation of the pipeline. This section also includes a description of the measures proposed for mitigating potential impacts on visual amenity.

17.4.1 Assessment methodology

The methodology for this assessment involved identifying landscape character units to describe areas throughout the Study Area typified by different features and settings. Following the identification of landscape character units, visual impacts were assessed based on the potential disturbance to the existing landscape character and the capacity for the landscape to absorb change. Once the potential visual impacts to each landscape unit were understood, a range of mitigation measures were then developed to minimise visual impacts, appropriate to the local landscape.

17.4.2 Existing environment

The existing environment and landscape character throughout the Study Area is highly variable due to a range of factors such as topography, local land uses and population size. In some areas the environment is of a rural character and is sparsely populated with isolated homesteads and small rural townships. In other areas, the existing environment is significantly more developed with a higher density of population, an advanced infrastructure network and industrial and commercial premises.

In order to accurately classify the existing environment within the pipeline Study Area, the landscape and visual characteristics of the area have been divided into four distinct landscape character units (refer to Table 17.9). The photographs provided in the following pages also give a representation of each of the four landscape character units.

Table 17.9 Landscape units and visual features of landscape

Landscape character unit	Visual features
Agricultural (KP222 – KP630)	Rural environment characterised by paddocks, fields, road networks, TSRs, isolated homesteads and small rural townships.
Liverpool Ranges (KP630 – KP675)	Vegetated, hilly terrain. The Liverpool Ranges dominate the landscape, alongside road networks and small rural townships.
Hunter River/Rural residential (KP675 – KP813)	The Hunter River flows through fairly flat terrain characterised by fields, paddocks, road and rail networks and small rural townships. The riparian zone close to the river itself is characterised by more dense vegetation.
Industrial (KP813 – KP825)	The environment is built up and consists of mainly heavy industry premises. This would relate to areas around Tomago and Kooragang Island and includes the Kooragang Island Coal Export Terminal and Tomago Aluminium.

Typical agricultural landscape

Typical Liverpool Ranges landscape

Typical industrial landscape

Part B

17.4.3 Potential impacts

This section describes the potential impacts on visual amenity during both the construction and operational phases of the proposal. Chapter 5 provides further details regarding the activities, machinery and equipment involved in the proposal that would potentially impact on the visual amenity of the landscape.

Construction

The following provides a description of the potential visual impacts resulting from relevant aspects of the construction process:

- **Construction within the pipeline easement –** temporary, short term visual impacts from the clearing of vegetation to create the pipeline easement and access tracks, impacts from construction workers, light and heavy vehicles, temporary storage facilities, temporary communications systems, machinery, plant and equipment, truck turn areas, limited night works and vehicle movements.
- **Construction camps –** temporary, short term visual impacts from the set up and operation of construction camps including temporary buildings and structures, construction workers, lights, light vehicles, buses and heavy vehicles.
- **Reinstatement and commissioning –** temporary, longer term visual impacts during the reinstatement/rehabilitation phase. This would be a period when any rehabilitation would be in the initial phases and may require a longer period for changes such as vegetation growth.

The extent of visual impacts from construction differ depending on the landscape units through which the pipeline traverses. The potential impacts during construction on visual amenity specific to each of the landscape units are described in Table 17.10.

Table 17.10 Visual amenity potential impacts during construction

Landscape unit	Potential impacts
Agricultural	The most significant visual impacts are expected on a limited number of isolated homesteads and small rural properties as a result of construction works. This includes impacts from vehicles, machinery and equipment, construction camps, construction crews and the pipeline easement.
Liverpool Ranges	Some construction works within the Liverpool Ranges would be undertaken at a high elevation thereby increasing the visual impacts for residents in areas such as Ardglen and Murrurundi. Once the pipeline easement has been cleared it is expected to result in visual impacts as the area is elevated and surrounded by a vegetated landscape. The Murrurundi area is also a heritage conservation area. Details relating to the heritage conservation significance of this area are discussed in Chapter 10.
Hunter River/Rural residential	The flat terrain characterising the Hunter River/Rural residential landscape unit would result in longer viewing distances. The area is more densely populated than the Agricultural and Hunter River/Rural residential landscape units, and as a result visual impacts would be experienced by a greater number of people. However, impacts are considered to be temporary and largely associated with the construction works.
Industrial	The visual impacts to industrial landscape units as a result of construction are expected to be minor. The landscape unit is already characterised by industrial development with associated plant, heavy machinery and vehicle movements. Whilst the construction process associated with the proposal would detract from the overall amenity of the landscape unit, the assessment found that the impact is only temporary.

Operation

The visual impacts associated with the operation of the pipeline would be minimal since the pipeline would be buried following completion of construction activities and reinstatement works. The number and location of above ground infrastructure facilities have not yet been determined and would form part of the detailed design phase of the proposal.

Potential impacts on visual amenity that may result from the proposal during the operation phase, for all landscape units identified, include:

- Permanent, long term visual impacts:
  - Presence of permanent facilities, such as MLVs, scraper stations, meter stations and telecommunications towers, changing the landscape character of certain regions.
  - Placement of marker signs at roads, crossings, fences, bends and other necessary locations, providing an obvious visual change to the existing landscape.
  - Changing landscape due to clearing of vegetation within the easement for construction and permanent maintenance of vegetation within the easement for the life of the proposal.
- Temporary, long term visual impacts:
  - Personnel and ground vehicles or aircraft, involved in regular maintenance trips.
  - Light produced by any night activities, such as pipeline emergency or maintenance works that may affect local communities.

17.4.4 Proposed mitigation and management measures

The measures proposed for mitigating impacts on visual amenity during both the construction and operation of the pipeline are set out in Tables 17.11 and 17.12.

Table 17.11 Visual amenity mitigation and management measures during construction

Potential impact	Mitigation and management measures
Reduced visual amenity along the ROW.	All plant, equipment and many heavy vehicles would travel almost exclusively along the ROW once delivered to the start of each pipeline spread in order to minimise impacts from vehicle movements. The likely exceptions to this procedure are described in Chapter 5.
	Selection of new access track routes would be based on consultation with all relevant landholders. Access track routes would be rehabilitated following construction, in consultation with landowners.
	Existing roads, tracks and disturbed areas would be utilised as far as practicable to minimise disturbance and visual impacts to the surrounding areas.
	Large mature trees within the ROW would be preserved where practicable.
	Night works would be limited in order to minimise impacts from light and noise.
	Clean up and reinstatement measures to the ROW and access tracks would be carried out in consultation with the relevant landholder/owner.

Potential impact	Mitigation and management measures
Reduced visual amenity in the vicinity of construction camps.	Construction camps would be located at least 500m from dwellings or other sensitive receivers. There would be no more than one camp per construction spread at any one time.
	Camp facilities would be temporary, transportable by road, established on a graded site and removed in a short time.
	Clean up and reinstatement measures to campsites would be carried out in consultation with the relevant landholder/owner.

Table 17.12 Visual amenity mitigation and management measures during operation

Potential impact	Mitigation and management measures
Reduced visual amenity along the ROW.	Areas that are visually sensitive would be identified in the CEMP and revegetation carried out in accordance with APIA Code.
Reduced visual amenity in the vicinity of above ground ancillary infrastructure.	Consultation with individual landowners on the location of above ground infrastructure facilities will be taken into consideration to minimise visual impacts.
	The installation of MLVs, scraper stations and meter stations would be near an access road, away from populated areas as far as possible and at least 100m from dwellings and sensitive receivers.

17.5 Greenhouse gas emissions and climate change

This section reviews greenhouse gas impacts on the proposal and greenhouse gas emissions from the proposal. Greenhouse gases comprise a variety of compounds, however carbon dioxide is considered to be the primary greenhouse gas and measurements are often provided as CO_2-e (carbon dioxide equivalent). Greenhouse gases are both naturally occurring and anthropogenic. Changes in greenhouse gases in the atmosphere affect the balance of incoming and outgoing radiation from the earth. Hence, these changes have the potential to alter global and regional climatic conditions over time.

Chapter 2 discusses the strategic context of the proposal with respect to national and state policies and plans to reduce greenhouse gas emissions and the potential impacts of climate change. For example, the *NSW Greenhouse Plan* commits the government to targets that aim to achieve a 60 per cent reduction in greenhouse emissions by 2050 and a reduction to year 2000 greenhouse emissions levels by 2025 *(NSW GH Plan, 2005)*. A key element of the Plan is the greater usage of gas for power generation within the State, which would be supported by the development of the QHGP.

17.5.1 Greenhouse gas emissions and electricity generation

Around 47 per cent of all greenhouse emissions in NSW result from energy generation *(NSW GH Plan, 2005)*. NSW's relatively high per capita emissions are due principally to the relative abundance of cheap fossil fuels and high dependence on coal-fired power generation. Approximately 91 per cent of NSW's electricity supply comes from coal-fired generation *(NSW GH Plan, 2005)*.

With access to competitively priced delivered gas and the potential for a national emissions trading scheme to be implemented, it is likely that the QHGP would positively influence investment in gas-fired technology by electricity generators and manufacturers. Reductions in greenhouse gas emissions resulting from using gas-fired generation as opposed to coal-fired generation for electricity generation have the potential to be significant due to the higher efficiencies achievable with gas and gas technologies. Greenhouse gas emission reductions such as this would make a material contribution to the NSW and Commonwealth Governments' greenhouse gas emission reduction targets.

The use of gas produces about 40 per cent less CO_2-e (carbon dioxide equivalent) when compared with coal (AGO, 2006). It also produces about 80 per cent less carbon monoxide and nitrogen oxides, as well as over 99 per cent less sulphur dioxides and particulates than coal (EIA, 1998). Hence, effectively replacing energy produced from coal with the equivalent energy produced by gas reduces emissions of greenhouse gasses and other substances.

Whilst there would be emissions of greenhouse gases produced by the construction and operation of the QHGP, the overall outcome from a greenhouse gas and climate change perspective is positive. This is primarily due to the nature of existing electricity generation and energy use in NSW, and in particular the Hunter region, as this region utilises coal for the vast majority of electricity generation.

17.5.2 Impacts of climate change on the proposal

The QHGP has an operational lifespan of greater than 40 years. As such, a consideration should be given to the likely climatic scenario that would be experienced during the long-term operation of the pipeline. In the Study Area, and throughout the surrounding regions, various scenarios have been modelled, based upon different levels of global emissions (CSIRO, 2007). Over the next 50 years, the modelled scenarios indicate an increase of temperature, as well as an increase in extreme temperature days, with levels of precipitation, whilst varying greatly between scenarios, being expected to decrease (CSIRO, 2007).

Aspects of anthropogenic and natural climate change that may impact upon the proposal are risks that have been taken into account in this assessment process (refer to Chapter 14), but these aspects may be exacerbated or otherwise altered by different climate change scenarios. Flooding is likely to increase in certain areas, due to changed weather and rainfall patterns. Coastal areas, such as those in the Newcastle region, may be subject to effects from sea level rise, which is expected to rise globally by between 18 and 59cm over the next 100 years (CSIRO, 2007). This rise would exacerbate impacts from extreme events such as storm surges. It is also predicted that there will be an increase in fire danger days and bushfires are expected to increase in frequency and intensity as a result of predicted climate change (CSIRO, 2007). These climate change impacts could potentially impact on above ground facilities but would not impact the underground gas pipeline.

The different scenarios for climate change in the longer term, say greater than 50 years, result from estimating the levels of emissions that are likely to occur during the period between now and then. Changes to global climate are predicted to result from higher levels of greenhouse gas emissions. Hence, if emissions are reduced over the next 50 years, impacts from climate change are likely to be less than if emissions increase during that period. This proposal is intended to provide an energy source that is lower in emissions than the current sources in the region.

17.5.3 Greenhouse gas emissions

Greenhouse gas emissions would be produced from a variety of sources associated with this proposal, both in the construction and operation phases. These range from the emissions from production of energy used in the manufacturing of the pipe to emissions from burning of gas by end users.

At this stage, sources and potential mitigation measures for greenhouse gases can be identified, but the specific emission levels for various activities are unable to be determined. For example, the number and distances of transport movements cannot be estimated until more details of the specific construction processes are determined. Similarly, fugitive emissions during the operation phase are difficult to estimate, however such emissions would be minimal and monitored for both safety and economic purposes.

Greenhouse gas emissions during construction

The following sources of greenhouse gas emissions would occur from the construction of the QHGP:

- Heavy and light vehicles, plant and equipment.
- Aircraft trips for project personnel.
- Emissions resulting from the production of energy used by the proposal infrastructure, such as construction camps.
- Emissions resulting from the manufacture of project materials, such as pipe.
- Temporary loss of the greenhouse gas sink would come from vegetation clearing.

Greenhouse gas emissions during operation

The following sources of greenhouse gas emissions would occur from the operation of the QHGP:

- Fugitive emissions during operation and maintenance, particularly at pipeline infrastructure such as scraper stations.
- Heavy and light vehicles, plant and equipment.
- Aircraft trips for pipeline inspections.
- Planned and unplanned (ie emergency conditions) gas releases.

17.5.4 Proposed mitigation and management measures

Mitigation and management measures that would be implemented to reduce the emissions from greenhouse gas emitting sources during construction and operation have been identified in Table 17.13.

Table 17.13 Greenhouse gas emission reduction and management

Greenhouse gas emission source	Stage	Management and mitigation measures
Exhaust emissions from transportation and production	Construction	• Adequate planning and maintenance to ensure efficient use of vehicles. This would include use of fuel-efficient and low-emissions vehicles as practicable.
Fugitive emissions	Operation	• Continuous monitoring system to detect leaks and a maintenance program to minimise fugitive emissions during operation.
Gas releases	Operation	• Minimise planned releases for maintenance work. • Minimise the risk of accidental releases through pipeline maintenance program, liaison with gas suppliers and safety measures (eg signage).

To minimise reductions in greenhouse gas sink, the area of vegetation clearing required would be kept to a minimum, leaving large trees where feasible, and encouraging vegetation regrowth post-construction through bush regeneration.

17.6 Cumulative impacts with other major developments

The cumulative impacts have been considered in regard to this project and also in relation to other major projects in the locality and region where the QHGP is proposed to be developed. To assess the cumulative impacts of this proposal and interactions with other major developments, a desktop review of available resources and screening and evaluation process was undertaken.

The desktop review included a search of the DoP website to identify approved and proposed developments within the vicinity (5km – either side of the alignment) of the QHGP proposal. This distance was considered to be appropriate based on the proposed width of the ROW (30m) and the potential zone of influence from this project in relation to others, in terms of noise, shared infrastructure (road networks) and other impacts.

Given that the proposal involves development of a gas pipeline, a search of the DoP website also included identification of approved and proposed gas pipeline developments within close proximity (locality and region) of the QHGP proposal. In some instances, further clarification was sought from DoP in regard to the status of these proposals. A summary of the proposed or approved developments identified from the DoP website is provided in Appendix M.

To assess whether cumulative impacts may exist between the QHGP proposal and other proposals or approved projects, the list of proposals was screened against adopted criteria, which included status and proximity of the proposed/approved development and timeframe for development and/or operation of the proposal and approved project. The screening process was undertaken to remove the proposals and/or projects that were not relevant, given the timeframe for development or operation, status and proximity to QHGP proposed development area (refer to Appendix M).

The relevant proposals were grouped according to region or locality and type of project and evaluated in terms of the cumulative impacts of the QHGP proposal, with respect to traffic, air quality, noise, land use and heritage. The proposals have been grouped as follows:

- **Tomago Road** – Redlake Enterprises Mixed Use Development, Tomago, Spent Potliner Processing Facility, Tomago Aluminium Smelter, Sandvik Machine Manufacturing and Maintenance Facility Project, and F3 Freeway to Raymond Terrace upgrade.
- **Kooragang Island** – Marstel Terminals Bulk Liquids Storage Facility, Newcastle Coal Infrastructure Group (NCIG) Coal Export Terminal Kooragang Island, and Kooragang Island Fuel Storage and Distribution and Biodiesel Production Facility.
- **Murrurundi** – Ardglen Hard Rock Quarry Extension.
- **Gas Pipelines** – Gas-fired Power Station and Related Projects, Narrabri and Surrounds, Liddell coal seam gas pipeline, Singleton; Lucas Energy Gloucester Basin pipeline, Maitland; Wilga Power Station (Eastern Star Gas Limited), Hunter Economic Zone (HEZ) development, State Significant Site and Project Application.

17.6.1 Tomago Road, Tomago

From a brief review of the proposals located at Tomago Road, Tomago, this area is very industrialised and there are a number of proposals and or approvals for further industrial/commercial development. In consideration of the developments and the area, traffic has the potential to be the most significant cumulative impact for this area and in relation to the QHGP proposal.

Impacts have the potential to be significant if proposals are occurring concurrently – during construction and/or operation of the above proposals and during the construction of the QHGP proposal. This is considered in relation to the number of employees and the identified traffic route (Tomago Road) for the QHGP proposal. Traffic impacts are not likely to be significant once the QHGP is operational, as the amount of traffic movements would be minimal during operation.

17.6.2 Kooragang Island

Kooragang Island is an industrialised area, with a number of heavy industries present, including chemical manufacturing and the coal loading terminals. Similar to Tomago Road, Tomago, traffic impacts are considered to be the most significant issue for this area and in relation to the QHGP proposal. Impacts would be most significant during the construction and/or operation of the above proposals and during the construction of the QHGP proposal, if occurring concurrently. Traffic impacts are not likely to be significant once the QHGP is operational. Traffic management, in terms of cumulative impacts, will be considered in the Statement of Commitments.

Land use conflicts may also exist between the QHGP proposal and the proposed NCIG Coal Export Terminal, given that the Study Area appears to be located on the Terminal property.

17.6.3 Murrurundi

The Ardglen Hard Rock Quarry Extension proposal is not an immediate concern in terms of cumulative impacts. When the quarry is extended in the future, there may be land use conflicts, as the gas pipeline alignment is located in the proposed extension area. These potential land use conflicts are being resolved with the landowner.

17.6.4 Other gas pipelines

The gas pipelines proposed appear to be specific for the needs of the local area or facility, ie the Liddell Power Station and the HEZ, and therefore would not have an impact on the QHGP proposal. However, the Gas-fired Power Station and Related Projects, Narrabri proposal may impact the QHGP proposal, in terms of competition and cumulative environmental impacts, should it proceed.

The status of the Narrabri and Wilga Power Station (proposed gas pipelines) projects are not known. The DoP has not received any further information, with the exception of a Major Projects application. Eastern Star Gas Limited has not provided any further information to DoP in regard to the proposed gas pipelines. However, consultation between QHGP project team and Eastern Star Gas Limited is ongoing. The Lucas Energy Gloucester Basin pipeline crosses the QHGP and this may have minor impact in terms of competition for gas markets.

18 Adaptive management of environmental constraints

18.1 Introduction

It is important to note that the proposal has the flexibility to avoid direct impacts on most known issues. The philosophy of avoidance is central for ongoing environmental management, as information is continually taken into consideration, collated and analysed during design and construction.

Part B of this EA has considered key and other issues through a screened assessment over the length of the proposal, to identify areas of potentially significant impact for more detailed field investigation.

This chapter outlines the fieldwork which will be undertaken closer to the time of construction to inform a more relevant localised and ground level understanding of the seasonal and site conditions and potential impacts and the implementation of site specific mitigation and management measures. In recognition of this, an adaptive management strategy is proposed in this chapter that details ongoing environmental management measures to enable best environmental outcomes through all stages of the proposal: from design, to construction and through to operation.

18.2 Adaptive environmental management

18.2.1 Design philosophy

A precautionary approach has been taken to avoid risks of serious or irreversible environmental damage. The approach to the elimination and management of environmental risks adopts the hierarchy of:

- **Avoid –** Through careful route selection as described in Chapter 3, key constraints and potentially significant impacts have been avoided. Further potential impacts have been avoided through the inherent features of the pipeline design, construction and operation as described in Chapter 5.
- **Mitigate –** Where potential impacts could not reasonably be avoided, specific mitigation and management measures would be implemented. These are described in respect of each of the issues assessed in Part B.
- **Offset –** Where potentially significant impacts could not reasonably be mitigated in relation to ecological and heritage impacts, offset strategies targeted to these impacts and aimed at achieving contribution to long term outcomes would be implemented.

The EA represents a screened assessment to identify potentially significant environmental impacts or constraints in order that these can be incorporated into the design philosophy to inform the ongoing development of pipeline design and alignment. The nature and scale of the QHGP is such that greater clarity and understanding of specific impacts will be progressively realised as the detailed project is developed and localised seasonal and site specific conditions in the field are known closer to the time of construction, particularly in relation to:

- Existing environment, informed by targeted field investigations of sensitive areas.

- Exact alignment of the ROW, as opposed to a 200m wide Study Area.
- Construction details, such as the location of temporary construction sites (pipe storage facilities, construction camps, etc).
- Outcome of consultation with stakeholders, including statutory authorities, landowners and the Aboriginal community.

Therefore, as the proposal progresses through the detailed design phase and prior to construction, the potential impacts on key and other issues and the development of specific mitigation and management measures would be able to be determined with more certainty with the benefit of fieldwork that is contemporaneous to the seasonal and site specific conditions for the localised construction area. This will enable the practical achievement of better environmental and social outcomes on the ground at the localised level.

The tiered environmental assessment has enable the identification of:

- The undertaking of fieldwork to understand impacts and associated management and mitigation options, refer to Section 18.2.2 below.
- The development of construction environmental management plans and mapping, to avoid and/or manage know areas of sensitivity (constraints), refer to Section 18.2.3 below.

18.2.2 Rationale for fieldwork

For the majority of the proposal, in areas identified as being of low to moderate impact or sensitivity, a general framework for the mitigation, management and monitoring of minor and proposal wide environmental issues has been provided in Part B of this EA.

As the environmental risk analysis in Chapter 8 and the specific assessments in Part B demonstrate, potential residual impacts of the proposal (ie after mitigation and management measures) are primarily associated with construction and therefore are localised to the area and period of construction.

Further consultation with landowners, stakeholders and relevant departments and agencies and localised fieldwork would provide information on the:

- Accuracy of desktop data, to confirm the sensitivities of the environmental issue (ie ground-truthing). This is particularly relevant for surface water and biodiversity.
- Extent (boundaries) of environmental issues. This is relevant for known significant Aboriginal heritage matters and determining the extent of vegetation mapping and communities, such as EECs.
- Requirements of statutory authorities, landowners, Aboriginal community and other stakeholders.
- Extent of construction related works. This would be relevant for impacts to human amenity and watercourse crossings.

The information gained from this fieldwork would be used to inform construction environmental management, to define constraints (with preference for avoidance) within the ROW and the development of location and issue specific mitigation and management measures that are appropriate to the seasonal and site specific conditions encountered in the field.

In terms of relevancy, this fieldwork should be undertaken with the latest and most up-to-date design details and the ROW. Fieldwork would be undertaken prior to construction, however the timing of fieldwork for certain environmental issues may vary to ensure that the most accurate environmental information is obtained. For example, biodiversity studies should be undertaken during peak breeding or flowering season and watercourse crossings should be assessed closer to the time of construction, to account for the hydrological flow regimes at the time of proposed crossing.

The following table summarises the key potential impacts that would require more detailed understanding through fieldwork conducted closer to the time of construction in the local area. Reference should be made to the relevant chapter in Part B of this EA and ongoing commitments outlined in Table 19.1.

Table 18.1 Fieldwork for environmental issues

Environmental issue	Chapter	Summary of fieldwork
Biodiversity	9	• Targeted field assessment of identified biodiversity constraint areas to confirm the condition and extent of EECs, and presence or absence of threatened flora or fauna species and endangered populations. • Survey areas of potential Koala habitat to identify any areas of core Koala habitat and as necessary develop site specific mitigations and management approaches based on the outcomes of the survey. • Survey areas identified as known and/or potential habitat for identified wetland birds, identified ground dwelling mammals and Green and Golden Bell Frogs, and develop site specific mitigations and management approaches based on the outcomes of the survey.

Aboriginal heritage	10.1	• Field investigation to confirm location and avoid known Aboriginal heritage areas of high significance:
		  • Euraba Mission.
		  • Euraba Whalan Creek.
		  • Wallalong Brush (general locality).
		• Ongoing Aboriginal consultation.

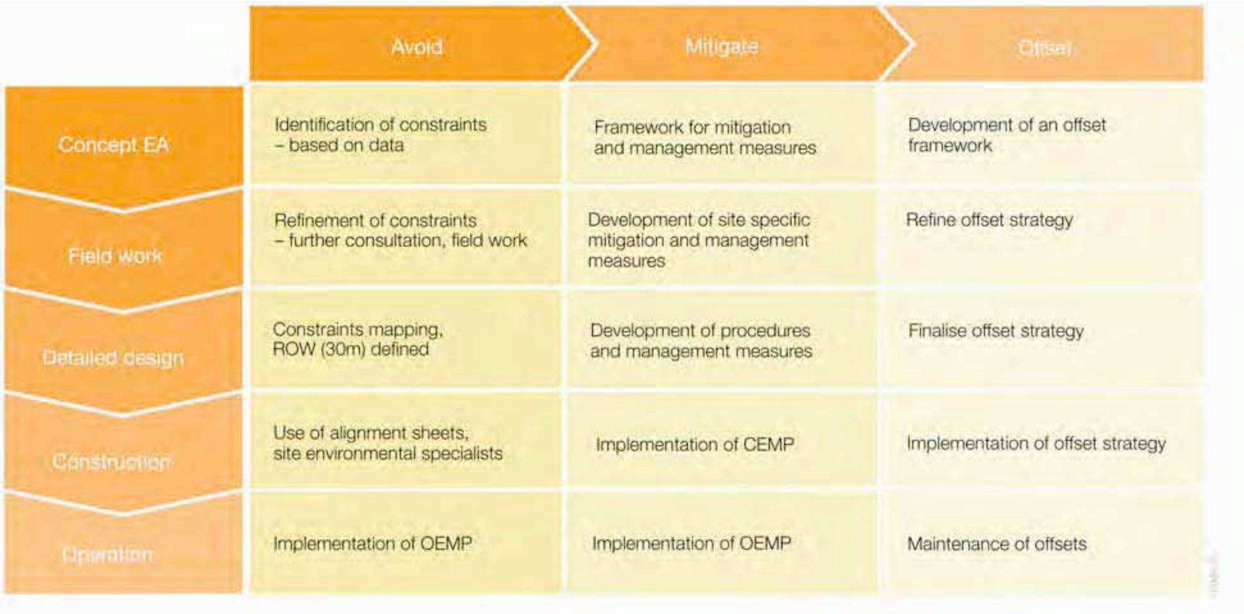
European heritage	10.2	• Field investigation to identify and avoid potential hard and moderate heritage constraints based on the predictive model.
Human amenity	11	• Ongoing landholder and local community consultation. • Locate areas for blasting and define procedures. • Understanding of localised traffic impacts and road crossing impacts.
Land use planning	13	• Continue to review proposed mine expansions that may impact the pipeline. • Continue consultation with the NSW Mine Subsidence Board. • Liverpool Plains Shire - Ardglen Quarry area – detailed investigation to avoid conflicts with future quarry expansion. • Muswellbrook Shire – consider new LEP for any land use conflicts. • Maitland Urban Settlement – review of residential investigation areas.
Hazards and risks	14	• Update quantitative and qualitative hazard and risk assessments during design phase.
Surface and groundwater	15	• Field assessment on watercourses identified as being of high sensitivity, to finalise crossing locations, methods and site specific management measures.
Infrastructure	16	• Continuing consultation with third party infrastructure owners. • Services searches to identify the exact service crossing requirements. • Engineering constraints considered in the detailed design in the vicinity of Ardglen and multiple asset crossings.

Environmental issue	Chapter	Summary of fieldwork
Resources	17	• Investigate and identify appropriate water sources for construction activities including hydro-testing and obtain relevant licences under Water Sharing Plans and *Water Management Act 2002*.
Soils and geology	17	• Conduct targeted geotechnical investigation prior to construction commencing.

18.2.3 Construction environmental management

The process for construction environmental management is shown conceptually in Figure 18.1 below. The process embodies the ongoing environmental assessment and management philosophy as noted in the preceding section.

Figure 18.1 Environmental management concept



Constraints mapping

Environmental constraints have been identified in Part B of this EA. Environmental constraints relate to:

- Known areas of high sensitivity, based on existing environmental data and developed assessment criteria.
- Potential areas of sensitivity, as identified through predictive modelling.

In accordance with the design philosophy, known constraints would generally be avoided by the construction ROW. To facilitate this, constraints mapping would be refined prior to construction based on the fieldwork identified in Table 18.1 with respect to the Study Area and the ROW.

Constraints mapping would include:

- Highly sensitive watercourses and water features.
- Biodiversity features – such as native vegetation, endangered ecological communities, threatened species locations and habitats.
- Registered contaminated sites.

- Places of heritage significance – both Aboriginal and European heritage, known and potential.
- Sensitive receivers – generally, receptors within 250m of the ROW.
- Areas of acid sulphate soil potential.
- Sensitive land use – such as horse studs and mining operations.
- Infrastructure crossings.

Constraints already identified through this EA, and as presented in Part B, are presented in Figures 18.2 to 18.18 of this chapter.

Additional constraints may be identified from fieldwork, detailed design, construction contractor requirements and ongoing consultation with stakeholders. Potential constraints would also be avoided, where practical, or identified for consideration during detailed design and construction. For constraints that would not be able to be avoided, procedures for management and mitigation of potential impacts would be developed and implemented through the CEMP (refer also to Part B of this EA).

Outcomes from constraint mapping would be included on detailed alignment sheets. The alignment sheets collate the engineering detail required for construction of each section of the pipeline, such as pipe types, depths of cover required, watercourse crossing types and bends in the pipeline. In addition, these sheets include information from the constraints mapping, such as endangered ecological communities, noxious weeds, cultural sites, land ownership and land use details (eg fences, wells, dams and irrigation). The alignment sheets also refer to the standard engineering drawings (eg minor watercourse crossing methods) and site specific drawings.

Construction Environmental Management Plan

During the detailed design phase, a CEMP (refer to Section 5.3.14 and Appendix B) would be prepared, which would detail the management of environmental issues identified in Part B of this EA.

The CEMP would be complemented by the alignment sheets. In this way, construction supervisors and other relevant staff have all the required information contained within these sets of drawings. Training and induction programs would include the use of the alignment sheets and other drawings, so that staff are particularly aware of when specialist advice is to be sought. For example, an alignment sheet may state that a culturally significant site is located at a particular KP and that the construction supervisor should contact the site environmental representative. That environmental representative would then refer to the CEMP or other relevant document to identify the nature of the site and the appropriate management measures that would be required.

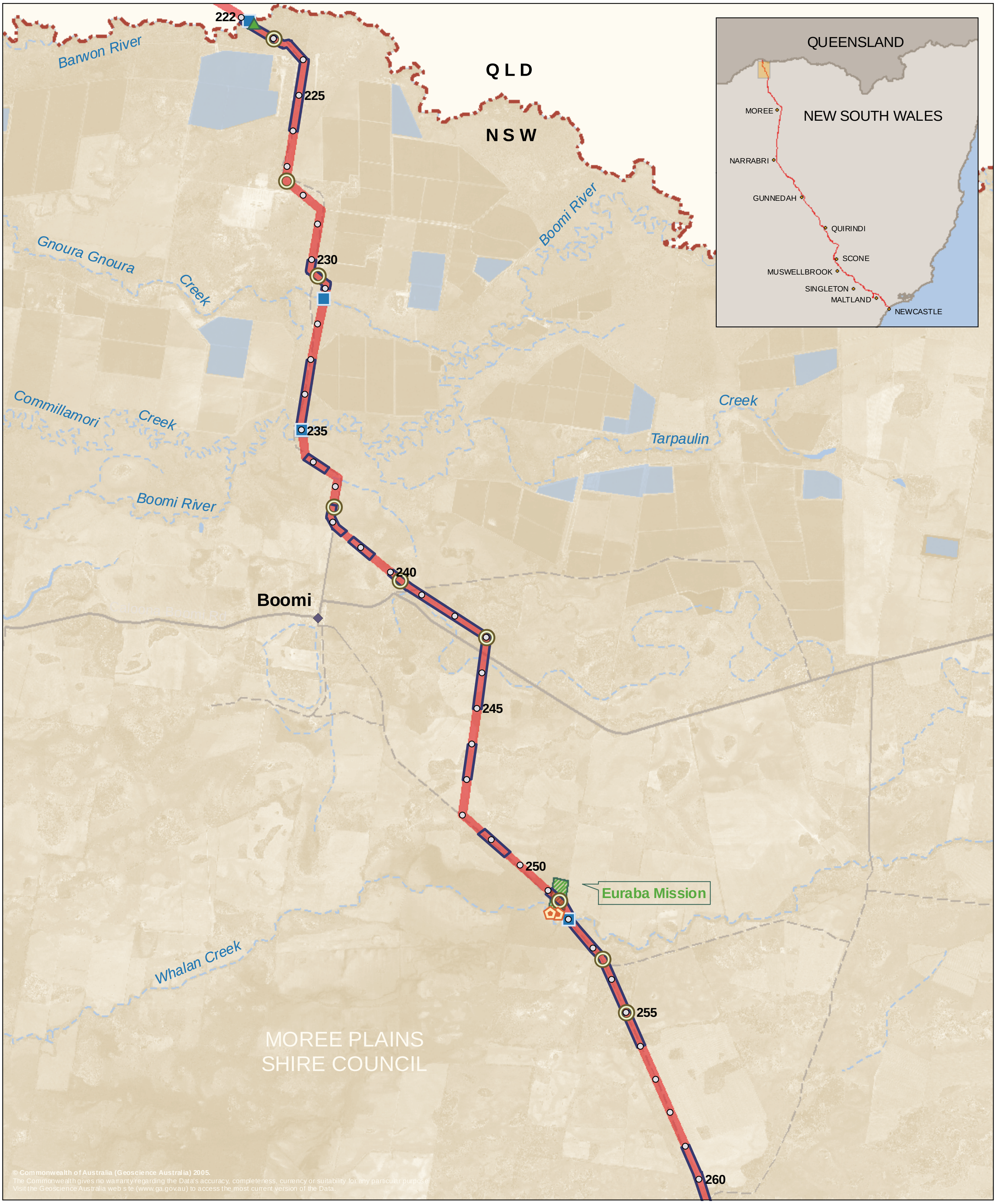
The CEMP would also include details regarding reinstatement of the ROW post-construction (refer to Section 5.7.2). This would reflect standard procedures, such as the APIA Code. However, in particular areas, information from landowner consultation or an environmental assessment that may provide specific reinstatement measures, would be detailed within the CEMP.

Monitoring and reporting

During construction, activities and works would be monitored on a regular basis and reported accordingly. Independent audits would also be undertaken periodically, for example at the beginning, middle and towards the end of the construction period.

18.2.4 Operational environmental management

An OEMP would be prepared for the QHGP. This plan would identify those measures, such as monitoring of erosion and noxious weed invasion, which would be undertaken for the life of the project. Operational activities, including maintenance of the pipeline and the easement, are discussed within Section 5.8. The OEMP would be a dynamic document, which would be amended over time to incorporate changes in technology, knowledge, standards, practices and project characteristics. It would be subject to periodic review and changes would reflect the outcomes of ongoing monitoring and auditing of the QHGP.



Drawing no. 07002g_CP_SI_01-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

- Kilometre point
- Study Area
- State border
- Potential surface water constraint
- TSR crossing
- Aboriginal heritage item
- Historical heritage item
- Historical heritage site
- Potential biodiversity constraint

Queensland Hunter
Gas Pipeline

Figure 18.2 Constraints analysis - Boomi region

1:140,000 (at A4)

0 1 2 3 4km

Drawing no. 07002g_CP_SI_02-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

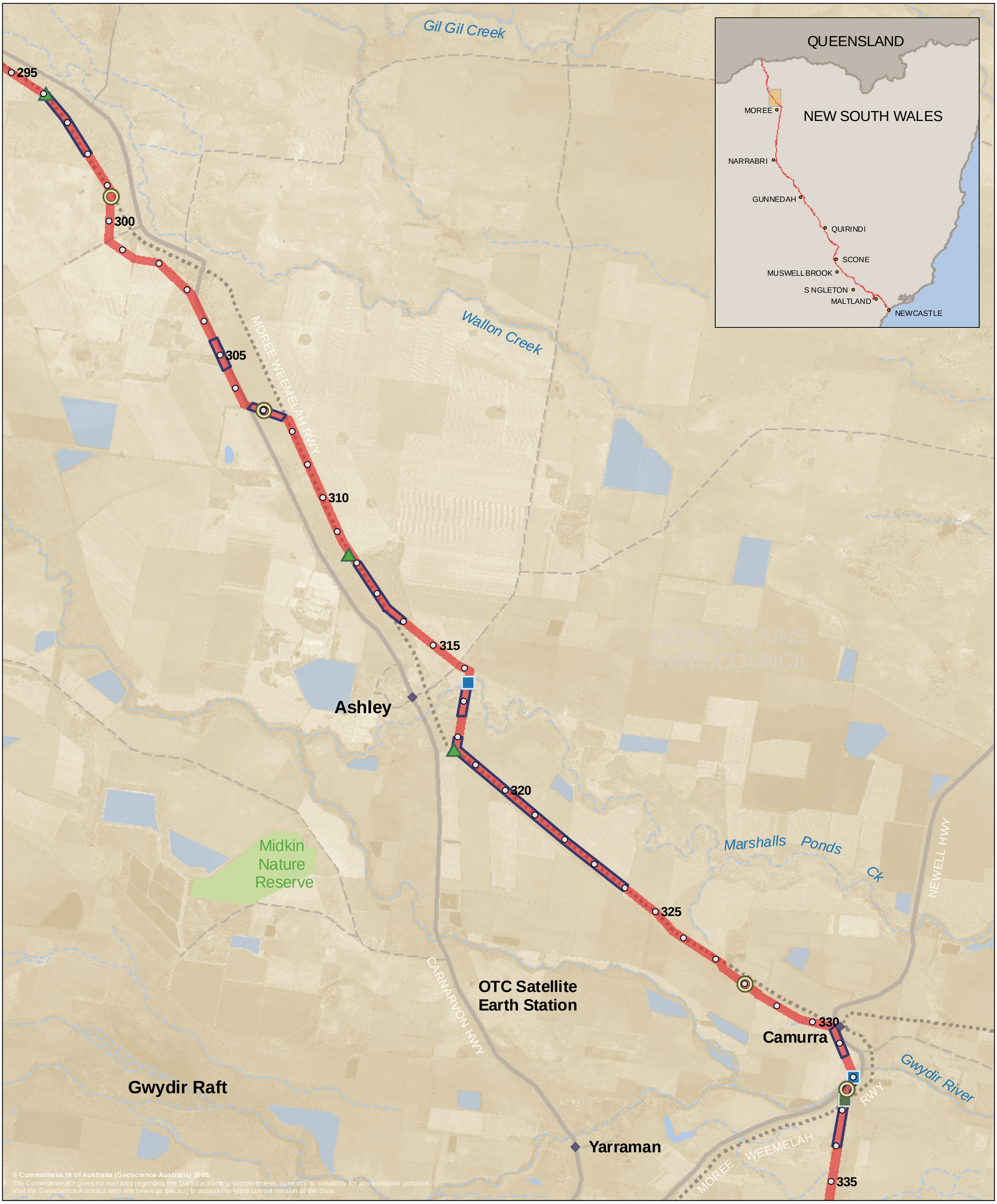
- Kilometre point
- Study Area
- Potential surface water constraint
- TSR crossing
- Potential biodiversity constraint

Queensland Hunter
Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.3 Constraints analysis - Garah region



Drawing no. 07002g_CP_SI_03-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

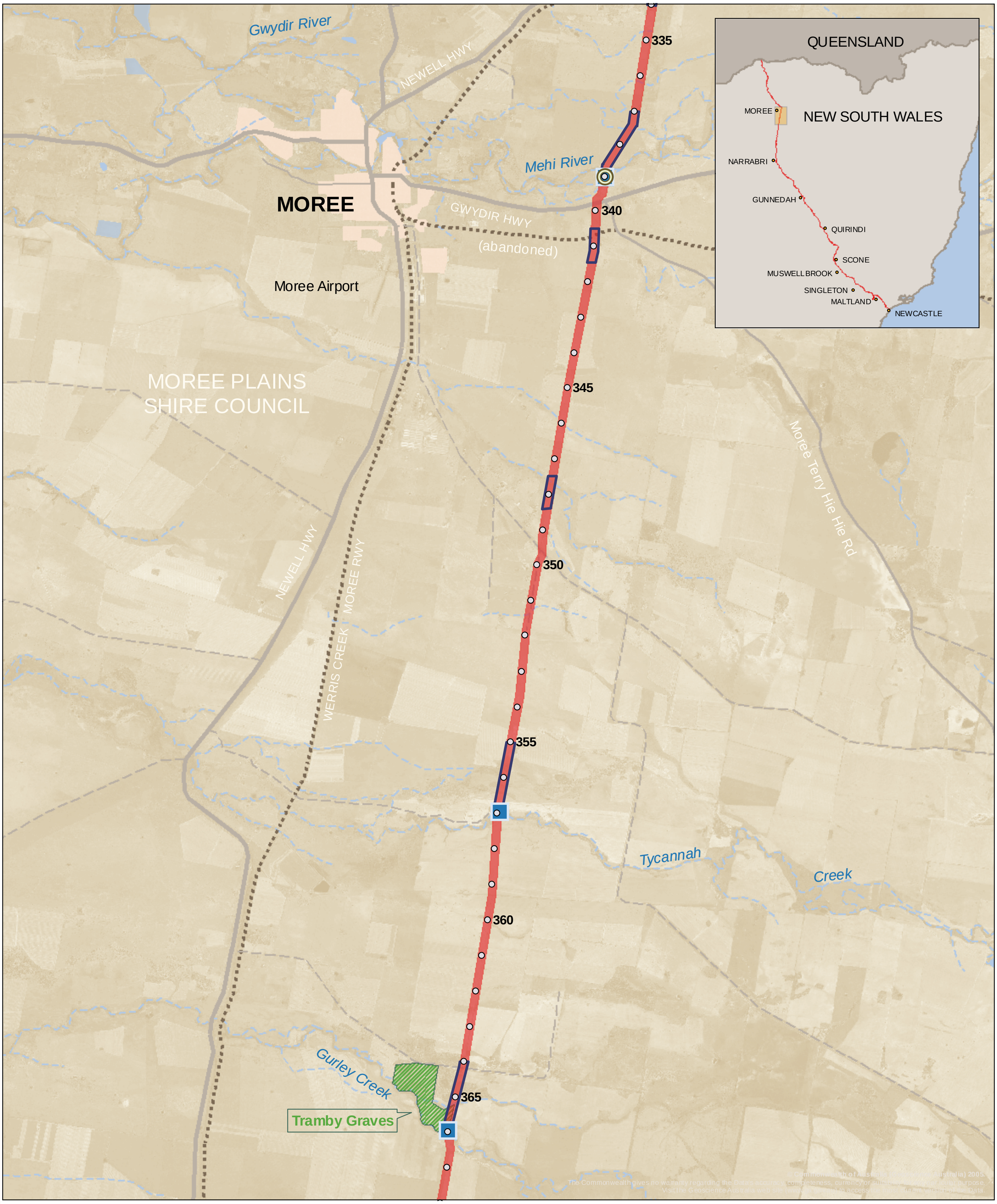
- Kilometre point
- Study Area
- Potential surface water constraint
- Potential infrastructure constraint
- TSR crossing
- Historical heritage item
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.4 Constraints analysis - Ashley region



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Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

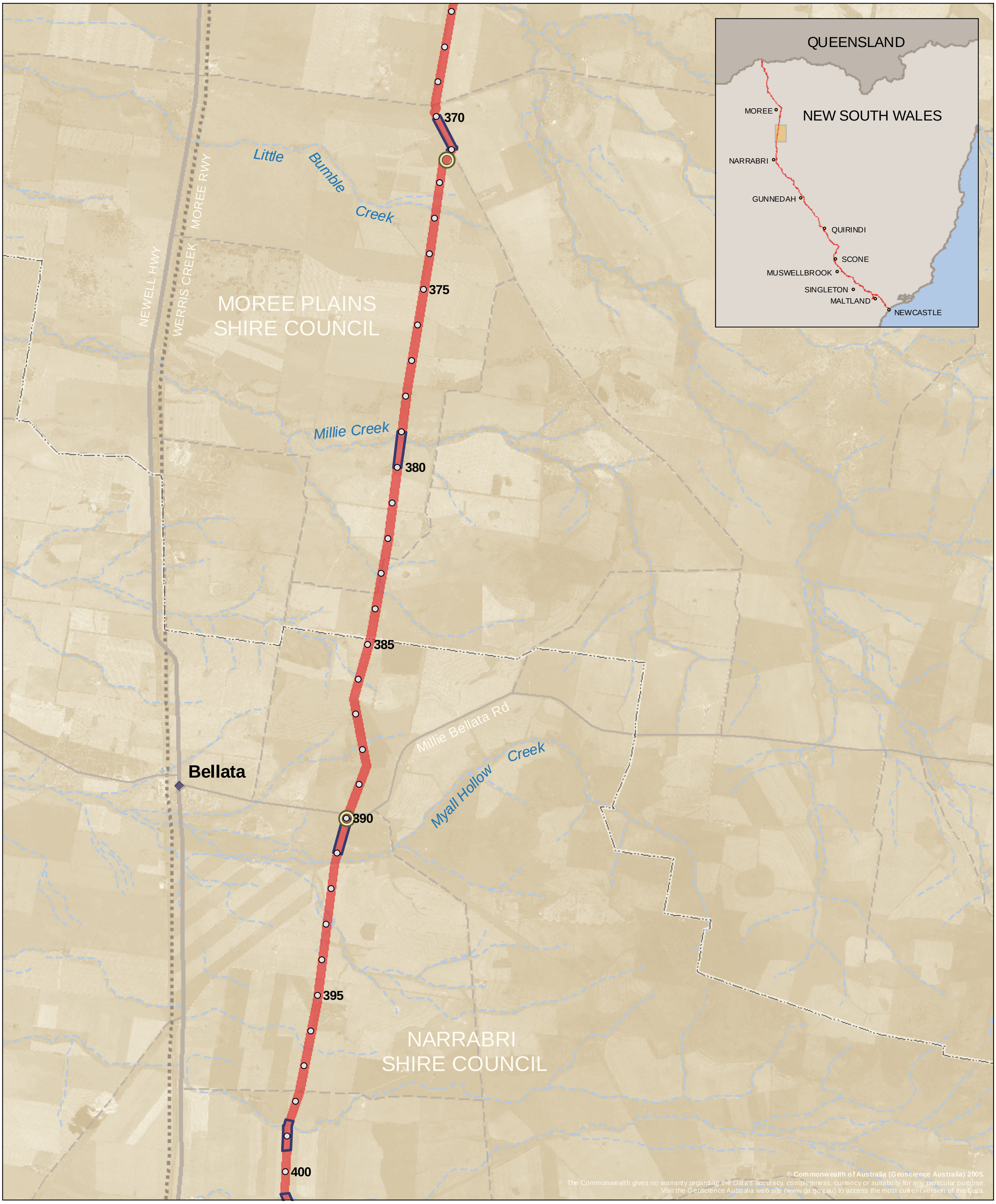
- Kilometre point
- Study Area
- Potential surface water constraint
- TSR crossing
- Historical heritage site
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.5 Constraints analysis - Moree region



Drawing no. 07002g_CP_SI_05-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

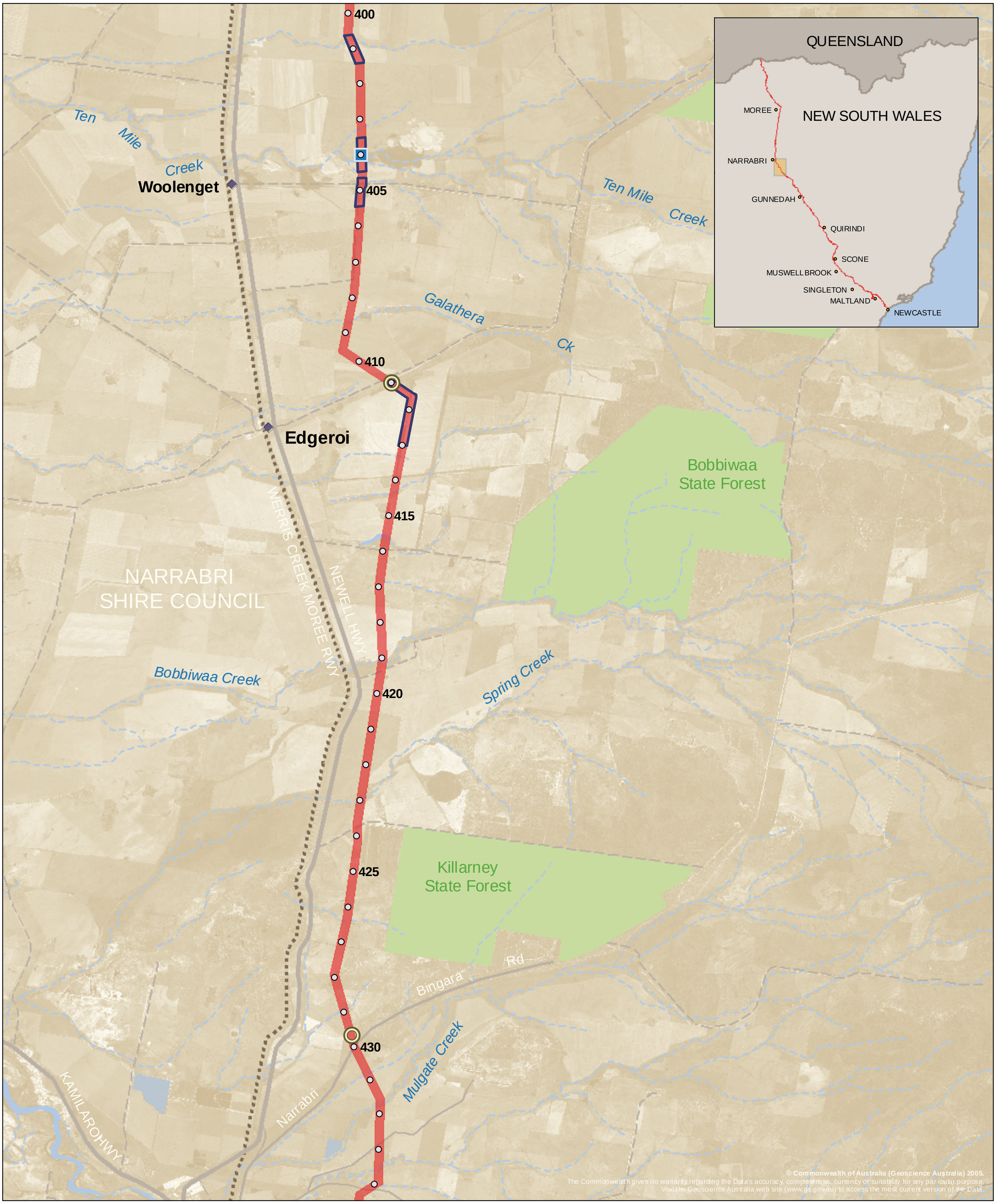
Datum GDA 94

Legend
- Kilometre point
- Study Area
- TSR crossing
- Potential biodiversity constraint

Queensland Hunter
Gas Pipeline

1:140,000 (at A4)
0 1 2 3 4km

Figure 18.6 Constraints analysis - Bellata region



Drawing no. 07002g_CP_SI_06-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend
- Kilometre point
- Study Area
- Potential surface water constraint
- TSR crossing
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.7 Constraints analysis - Narrabri north region

Drawing no. 07002g_CP_SI_07-1

Date 03 September 2008

Source Geoscience Australia RLMS Pty Ltd AHMS Pty Ltd ngh environmental

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Potential surface water constraint
- TSR crossing
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

Figure 18.8 Constraints analysis - Narrabri region

1:140,000 (at A4)

0 1 2 3 4km

Drawing no. 07002g_CP_SI_08-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

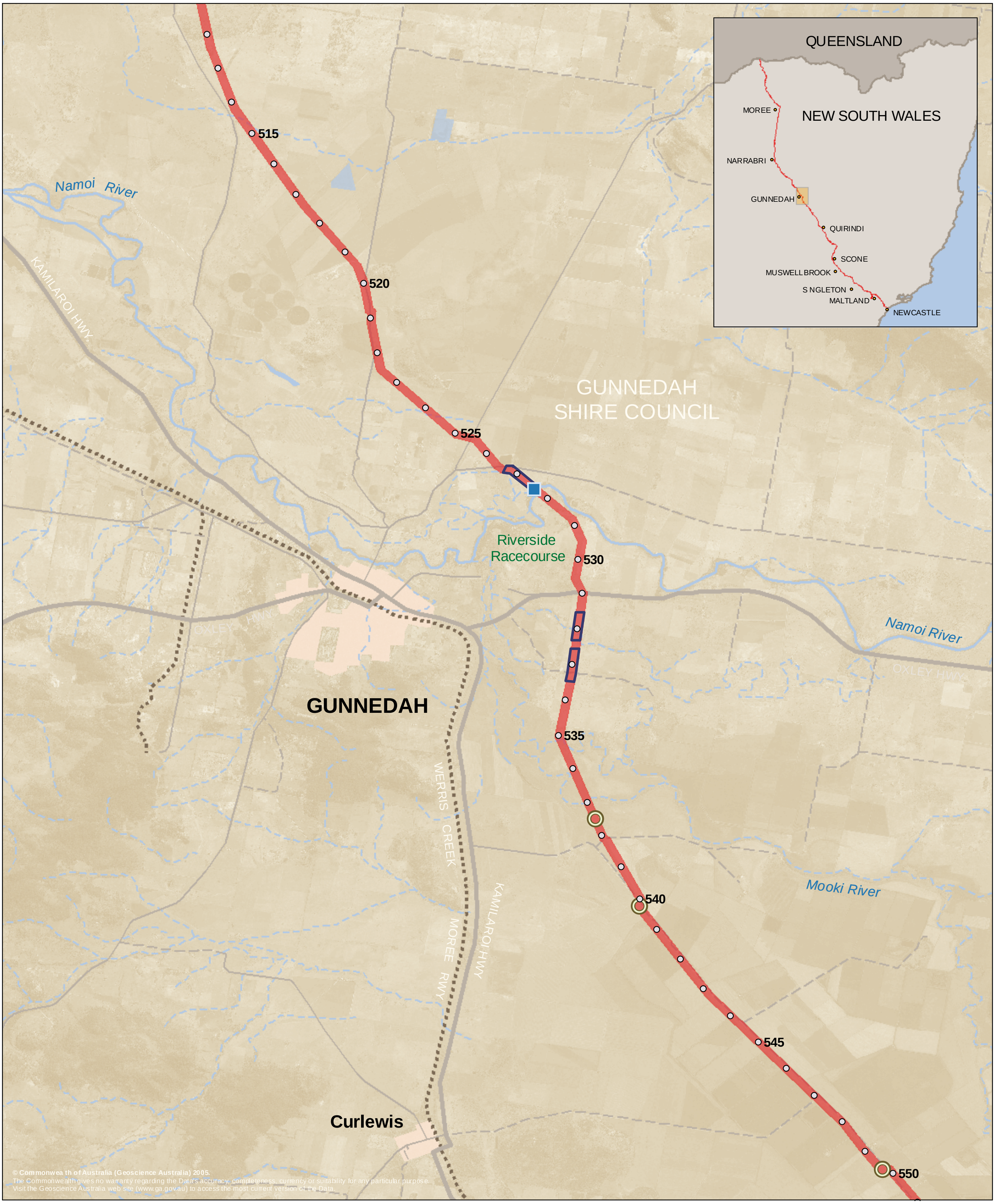
Legend
- Kilometre point
- Study Area
- Potential surface water constraint
- TSR crossing
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.9 Constraints analysis - Boggabri region



Drawing no. 07002g_CP_SI_09-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend
- Kilometre point
- Study Area
- Potential surface water constraint
- TSR crossing
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)
0 1 2 3 4km

Figure 18.10 Constraints analysis - Gunnedah region

Drawing no. 07002g_CP_SI_10-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

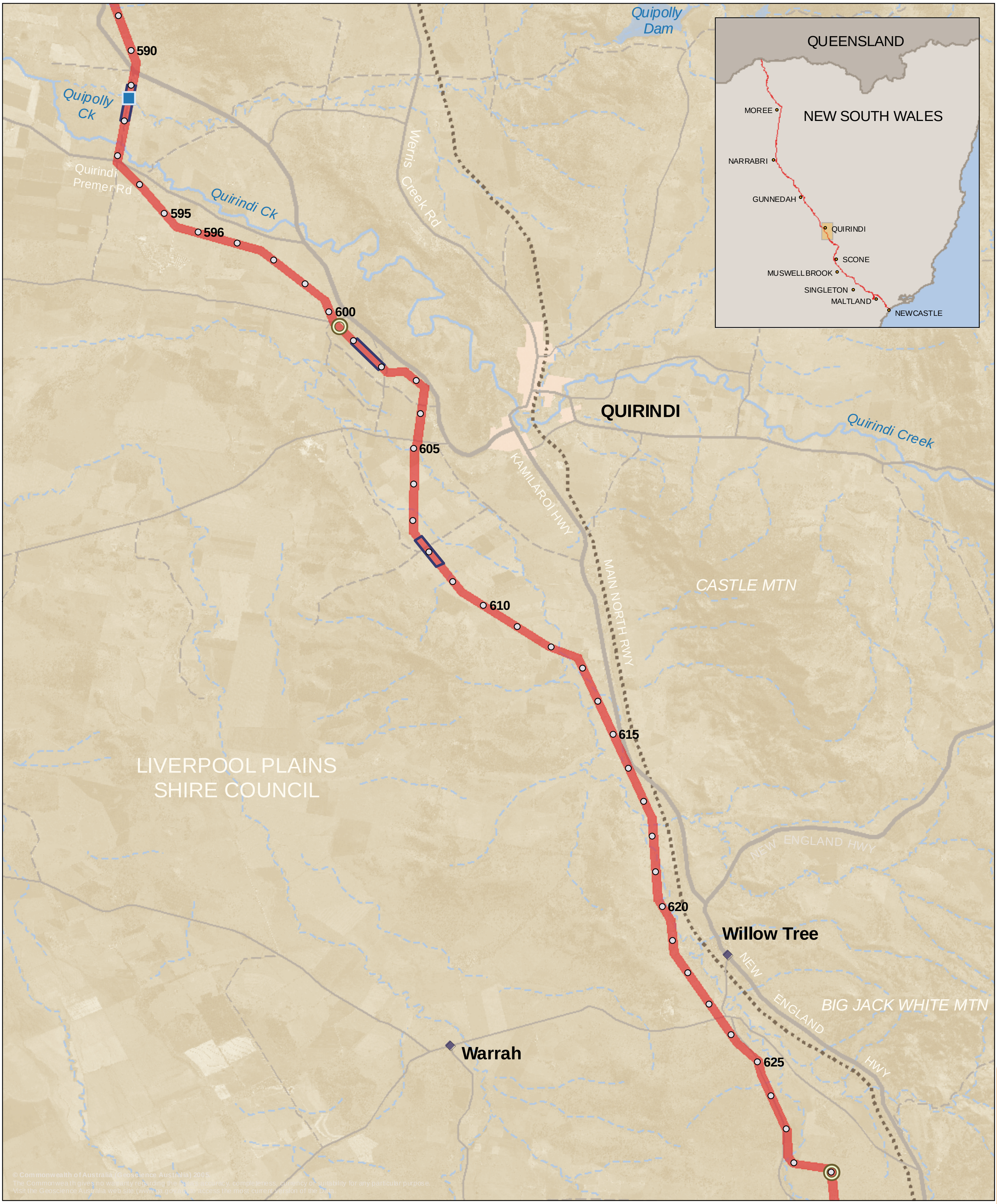
- Kilometre point
- Study Area
- Potential surface water constraint
- Infrastructure constraint
- TSR crossing
- Historical heritage item
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

Figure 18.11 Constraints analysis - Breeza region

1:140,000 (at A4)

0 1 2 3 4km



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Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

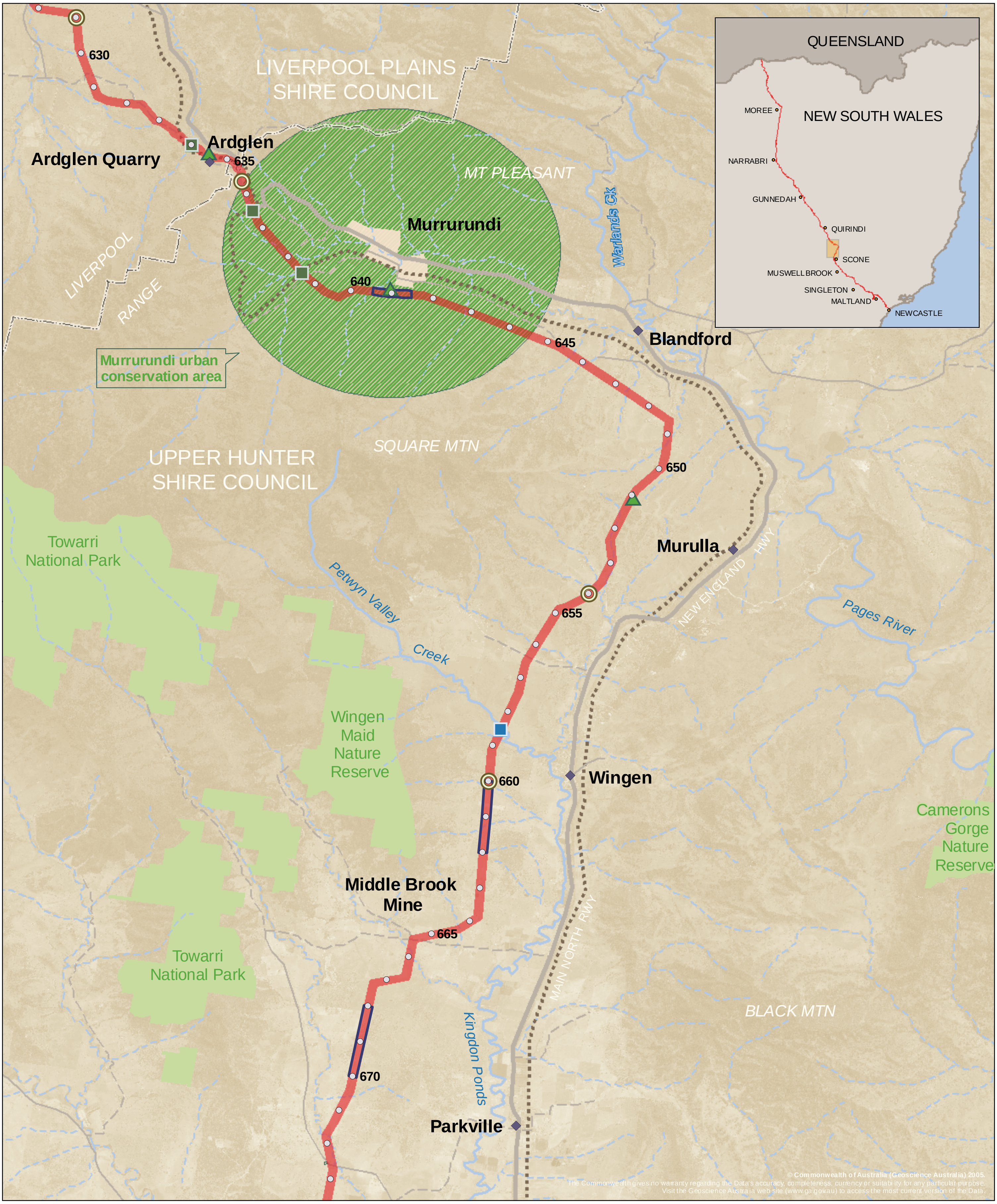
Legend
- Kilometre point
- Study Area
- Potential surface water constraint
- TSR crossing
- Potential biodiversity constraint

Queensland Hunter
Gas Pipeline

Figure 18.12 Constraints analysis - Quirindi region

1:140,000 (at A4)

0 1 2 3 4km



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Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

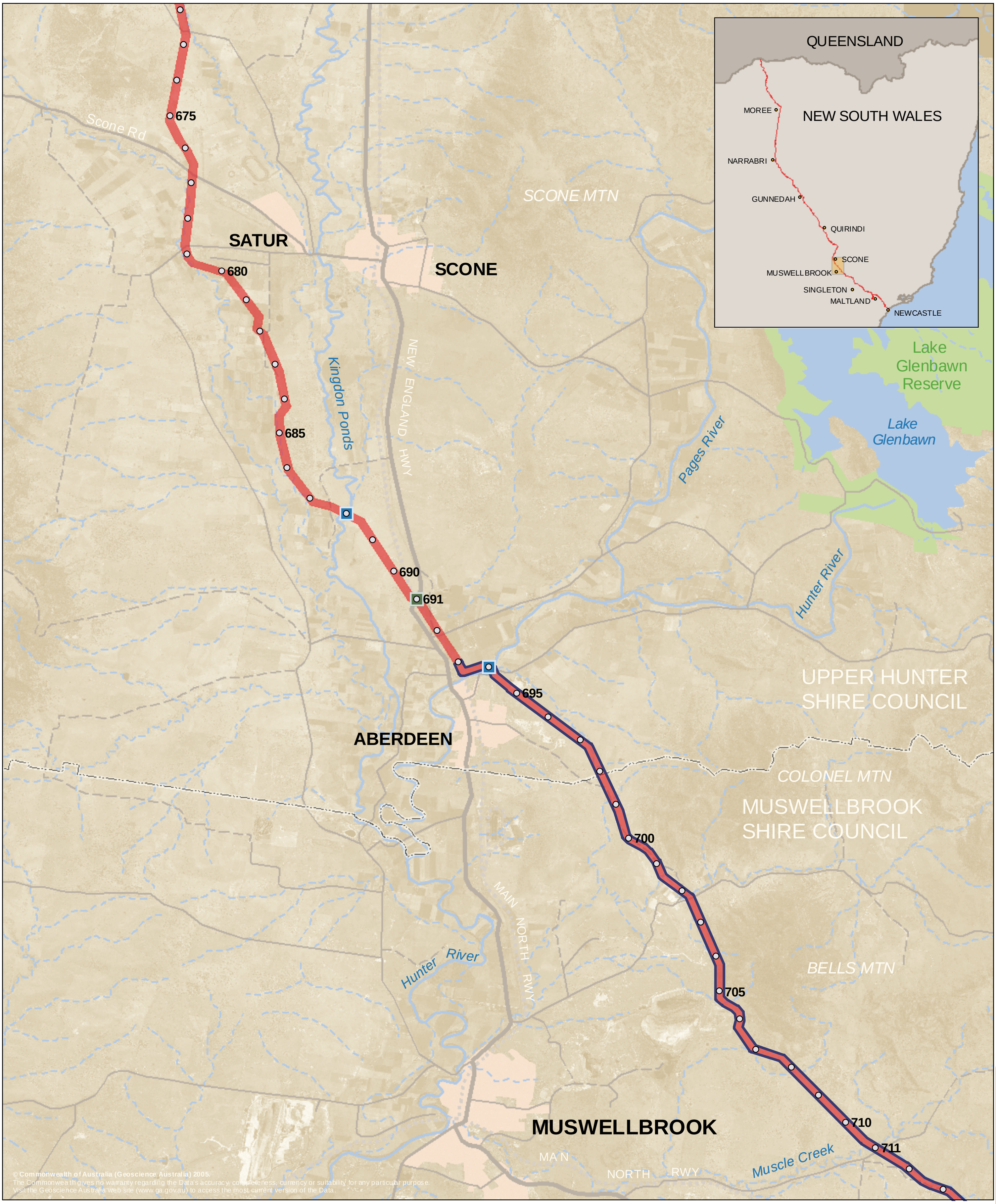
- Kilometre point
- Study Area
- Potential surface water constraint
- Infrastructure constraint
- TSR crossing
- Historical heritage item
- Historical heritage site
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.13 Constraints analysis - Murrurundi region



Drawing no. 07002g_CP_SI_13-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

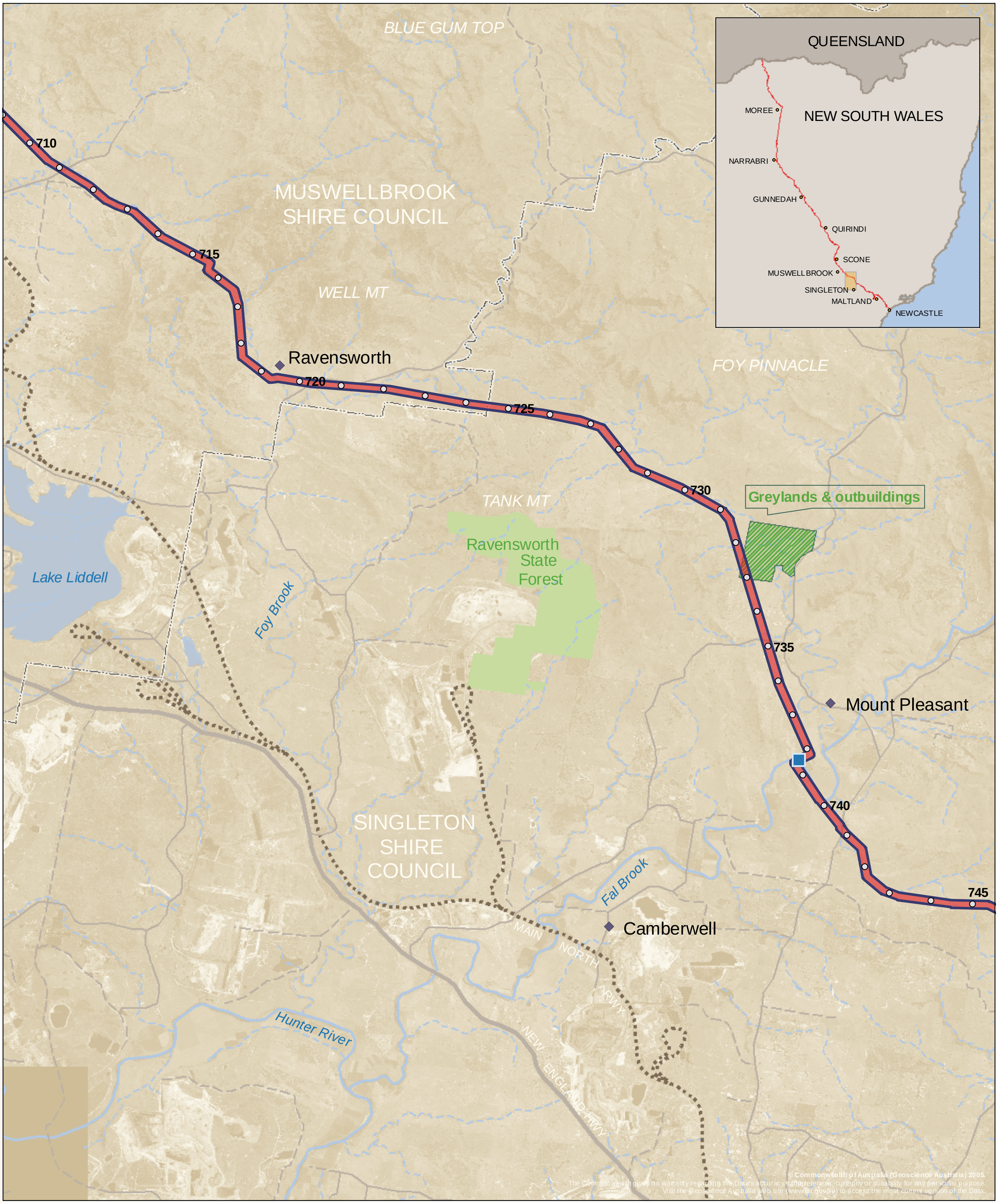
- Kilometre point
- Study Area
- Potential surface water constraint
- Infrastructure constraint
- Potential biodiversity constraint

Queensland Hunter **Gas Pipeline**

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.14 Biodiversity constraints - Muswellbrook region



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Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

Legend

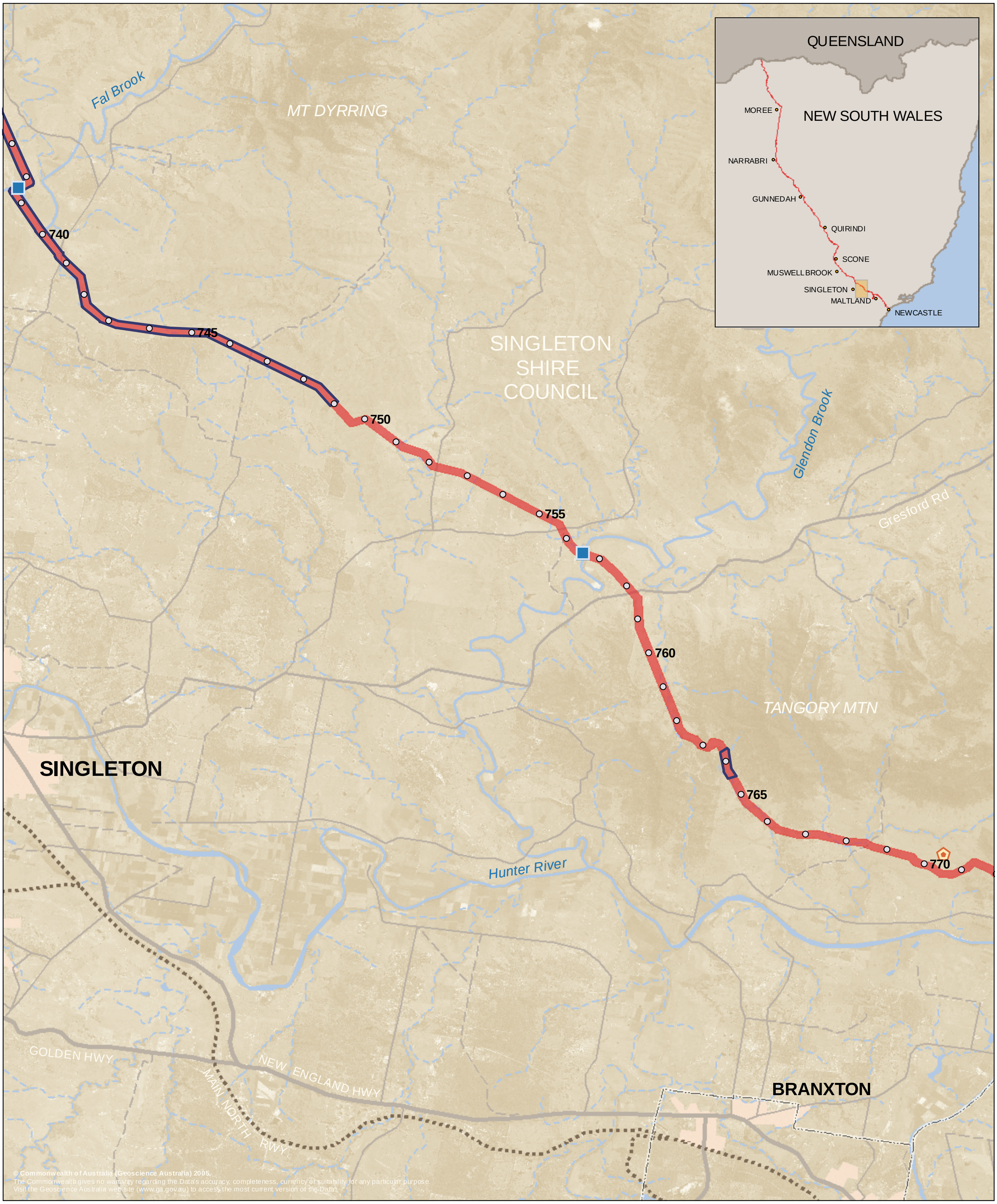
- Kilometre point
- Study Area
- Potential surface water constraint
- Historical heritage site
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.15 Constraints analysis - Singleton north region



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Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental

Datum GDA 94

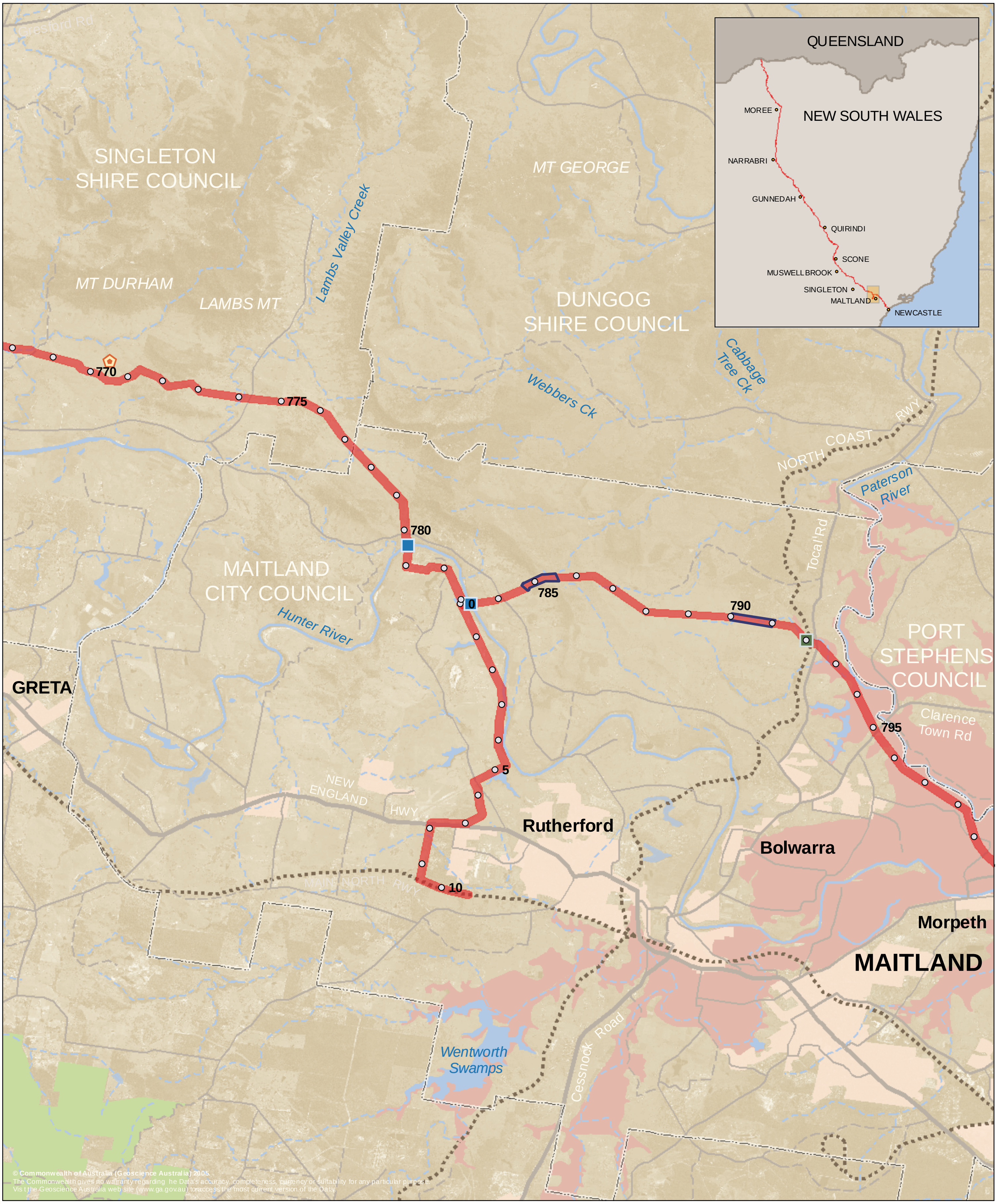
Legend
- Kilometre point
- Study Area
- Potential surface water constraint
- Aboriginal heritage item
- Potential biodiversity constraint

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.16 Constraints analysis - Singleton east region



Drawing no. 07002g_CP_SI_16-1

Date 03 September 2008

Source Geoscience Australia RLMS Pty Ltd AHMS Pty Ltd ngh environmental

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Potential surface water constraint
- Infrastructure constraint
- Aboriginal heritage item
- Potential biodiversity constraint
- Acid sulphate soils - high risk

Queensland Hunter Gas Pipeline

1:140,000 (at A4)

0 1 2 3 4km

Figure 18.17 Constraints analysis - Maitland region

Drawing no. 07002g_CP_SI_17-1

Date 03 September 2008

Source Geoscience Australia
RLMS Pty Ltd AHMS Pty Ltd
ngh environmental NSW DECC

Datum GDA 94

Legend

- Kilometre point
- Study Area
- Potential surface water constraint
- Potential biodiversity constraint
- Registered contaminated site (DECC)
- Historical heritage site
- Acid sulphate soil - high risk
- Ramsar site

Queensland Hunter Gas Pipeline

Figure 18.18 Constraints analysis - Newcastle region

1:140,000 (at A4)

0 1 2 3 4km

19 Draft Statement of Commitments

19.1 Overview

An overview of the EA process undertaken for this proposal is provided in Chapter 8. In relation to each of the environmental issues assessed a number of mitigation and management measures have been identified with the aim of minimising or mitigating, as far as practical, any adverse impacts associated with the proposal. Additionally, given the nature and context of the EA, areas were identified for localised field investigation prior to construction of the proposal as part of an adaptive management strategy outlined in Chapter 18.

The combination of proposed mitigation and management measures, and areas for localised field investigation as part of an adaptive management strategy, have informed the development of the draft, high level, principle based SoCs that the proponent will undertake as part of the ongoing development of the proposal. The draft SoC may be revised in response to stakeholder and community input during the display of the EA.

Following determination of the EA and pending approval of the QHGP proposal, the revised commitments would guide subsequent phases of the development and delivery to minimise impacts on the environment. Any consortium or contractor involved in any future planning approvals, design, construction and/or operation phases of the proposal would be required to undertake all works in accordance with the SoCs.

19.2 Draft commitments

The draft SoCs in the following table includes:

- An objective.
- Details of the high level, principle based commitment.
- The timing of when the commitment applies (prior to construction, construction and during operation).
- Reference to any key sections of the EA, documents or guiding principles influencing the objective and implementation of the commitment.

Table 19.1 Draft Statement of Commitments

Objective	Ref #	High level principled commitment	Timing	Reference
Proposal overall				
Ensure sound environmental management of the proposal.	P1	Management of environmental aspects of the pipeline construction and operation will be guided by the APIA Code.	Prior to construction, construction, and operation	APIA Code 2005 (or latest edition).
Ensure objectives of adaptive management are met.	P2	Each construction spread will have a manager designated with responsibility for ensuring that the objectives of adaptive management and the SoCs are met.	Prior to and during construction	Chapter 18 of the EA
Pipeline route finalisation				
Ensure final route minimises impacts on natural and built environment.	RI	Final route alignment will be carefully selected by applying the route selection process, objectives and criteria described in Chapter 3 of the EA.	Prior to construction	Chapter 3 of the EA
	R2	Any alignment changes outside of the Study Area will be subject to a consistency assessment, informed through a desktop assessment of each of the environmental issues identified by applying the same methodology used in this EA. Any potentially significant impacts identified will be investigated and managed.	Prior to construction	Chapter 7 of the EA
	R3	Where any final alignment changes outside of the Study Area are significantly inconsistent with the Part 3A approval of the proposal, the proponent will apply for modification under section 75W of the EP&A Act.	Prior to construction	EP&A Act Chapter 7 of the EA
Construction management				
Management systems in place for protection of environment.	CM1	A Construction Environmental Management Plan (CEMP) will be developed in consultation with DECC, DPI and DWE to manage environmental issues assessed and implement identified mitigation and management measures where required.	Prior to construction	Part B of the EA Chapter 5 of the EA.

Objective	Ref #	High level principled commitment	Timing	Reference
Minimise impacts associated with the location and operation of temporary construction camps, storage and depots.	CM2	Construction camps, pipeline storage areas and vehicle depots will be located in accordance with the criteria set out in Chapter 5.	Prior to construction and during construction	Chapter 5 of the EA
Minimise impacts on human amenity as a result of construction hours.	CM3	Construction works would be undertaken between 7am and 6pm, seven days a week for 28 days and then nine days off, except in the following instances where extended construction hours may occur when: • HDD drill rig is in operation until completion of the HDD bore (continuity of process required). • Boring is in operation until completion of the boring. • Water filling of the pipeline and pumping pressure is required to be obtained for hydro-testing (continuity of process required). • Extenuating circumstances out of the control of the project (such as weather, industrial relations) result in delays to the pipeline program, notice would be given to the DoP Director-General with an outline of proposed work hours and schedule. • Works do not pose an audible disturbance to any residences. • Transport of plant, equipment and pipe by oversized trucks outside of hours as required by authorities for safety reasons. • It is required in an emergency to avoid injury or loss of life, property and/or to prevent environmental harm. • Agreement is reached with local residents in order to reduce the duration of construction activities and/or manage other traffic, amenity or disturbance issues.	Construction	Chapters 5 and 11 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
	CM4	Where construction noise is audible at the major level at sensitive receivers, consultation with impacted residents will be undertaken 48 hours in advance of work and during the local construction period as necessary. The level of major audibility at sensitive receivers is 50dBA at isolated residences and 55dBA at township residences.	Construction	Chapters 5 and 11 of the EA The construction noise criteria within Table 11.2 has been set to correspond to DECCs *Environmental Noise Control Manual.*
	CM5	Blasting will be scheduled to 9am to 5pm Monday to Saturday. No blasting will be scheduled for Sundays or public holidays.	Construction	Chapters 5 and 11 of the EA
Community and stakeholder consultation				
Ensure effective and receptive consultation with community and other stakeholders is continued.	C1	An integrated stakeholder consultation process will continue to be implemented throughout the project. The outcomes of ongoing consultation will continue to influence the project.	Prior to construction, construction, and operation	Chapter 6 of the EA
Ensure responsiveness to issues and concerns raised by the community.	C2	A 24-hour toll free contact telephone number will be established. A system to receive, record, track and respond to issues and concerns will be implemented.	Prior to construction and during construction	AS4269 Complaints Handling Chapter 11 of the EA
Ensure liaison with key government stakeholders.	C3	The proponent will establish a framework for ongoing liaison with representatives of the DECC, DPI, DWE and DoP.	Prior to construction and during construction	Chapter 6 of the EA
Biodiversity				
Minimise impacts to riparian vegetation.	B1	Measures will be implemented to prevent and/or minimise harm to riparian vegetation that may result from construction and/or operation of the pipeline. Crossing points will be selected to minimise the extent of riparian vegetation clearing and limited to the narrowest area practicable.	During construction	Chapter 9 of the EA Commitment reference W1, C3
Minimise native vegetation disturbance.	B2	Equipment storage areas and stockpile areas will be located away from riparian zones within existing cleared or degraded lands.	During construction	Chapter 9 of the EA
Minimise impacts to Pink-tailed	B3	Construction timing will be developed in consideration of	Prior to construction	Chapter 9 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Worm Lizard, Border Thick-tailed Gecko, and Long-legged Worm Skink.		avoiding relevant sensitivities in the lifecycle of these species, including breeding times, following outcomes of identified fieldwork.		
	B4	Where identified potential habitat exists in the final ROW, a qualified ecologist will inspect the potential habitat prior to construction. Individuals found in the ROW will be relocated to adjacent suitable habitat outside of the ROW.	During construction	Chapter 9 of the EA
Minimise the spread and/or establishment of weeds.	B5	Weed management measures will be developed for incorporation into the CEMP, taking into consideration: • A review of relevant desktop information relating to relevant noxious and environmental weed listings. • Results of biodiversity fieldwork. • Liaison with landowners regarding any locally occurring weed management issues or existing management arrangements.	Prior to construction	Chapter 9 of the EA Commitment reference L3
	B6	Any excavated material containing weeds will not be stored near waterways or existing stands of native vegetation.	During construction	Chapter 9 of the EA
	B7	Noxious weeds in areas disturbed by construction activities will be managed for a minimum of two years post completion.	Operation	Chapter 9 of the EA
Minimise impacts to hollow dependent and other fauna in identified sensitive woodland areas.	B8	In those areas identified by survey as sensitive woodland areas for nesting fauna species, a qualified ecologist will check hollow bearing trees prior to clearing in the ROW. Fauna found nesting will be relocated to suitable adjacent habitat.	During construction	Chapter 9 of the EA
	B9	Stands of vegetation in identified sensitive woodland areas in the ROW containing hollow bearing trees will be cleared using a two stage clearing process with adjacent non-hollow bearing trees to be cleared first.	During construction	Chapter 9 of the EA
	B10	Logs, dead trees and other habitat features in identified sensitive woodland areas will be relocated from the area of clearing to provide habitat in adjacent areas where feasible and	During construction and operation	Chapter 9 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
		practical during construction. Habitat features will be reinstated within the ROW, following construction.		
	B11	Nest boxes (as necessary) will be fixed to suitable retained vegetation, in a way that does not damage the tree.	During construction and operation	Chapter 9 of the EA
Minimise impacts to native fauna species.	B12	The maximum length of open trench will be no more than 70km per construction spread at any one time. Dedicated personnel will survey the open construction trench ahead of construction works daily. Any trapped fauna species will be relocated. Additional measures to protect fauna during construction, including the provision of fauna refuges will be further explored.	During construction	Section 5.3, Figure 5.2 of the EA Chapter 9 of the EA Commitment reference P2
Minimise impacts to aquatic habitat and fish species during crossing of identified sensitive waterways.	B13	Watercourse crossings for all sensitive waterways will be designed so as not to preclude fish passage, where necessary in consultation with the DPI.	Prior to construction	*Fishnote: Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW Fisheries) Chapter 9 and Chapter 15 of the EA Commitment reference: W1, W5, W6, W7.
Minimise biodiversity impacts from operation of the proposal.	B14	Maintenance staff will be informed of the importance of any reinstated habitat to ensure that it is not removed as part of access maintenance during the operation of the pipeline.	Operation	Chapter 9 of the EA
Minimise impacts to woodland bird species.	B15	In areas identified as potential movement corridors for avifauna, and in consultation with a qualified ecologist, the following mitigation measures will be implemented: • Reduction in the width of the ROW to minimum necessary to construct the pipeline. • Site-specific revegetation and management plans to ensure that the corridor is restored as far as practicable to its original state. • Construction timing that is sympathetic to the lifecycle sensitivities of the relevant species identified through fieldwork surveys.	During construction	Chapter 9 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Minimise specific impacts to endangered ecological communities and threatened flora species.	B16	An extent and condition survey will be undertaken of potential EECs and threatened flora species identified as being potentially impacted within the Study Area. The survey will aim to confirm the presence or absence of these EECs and threatened flora species within the Study Area. Results from the survey will be used to optimise the final alignment of the proposal, and inform the development of specific mitigation and management measures, as necessary.	Prior to construction	Chapter 9 of the EA
Offset any residual impacts of the proposal on biodiversity so as to ensure an improvement in biodiversity values in the area in the long term.	B17	The requirement for development of an offset strategy will be made on the basis of the outcomes of the extent and condition survey, and in consideration of the following: • The likely impacts of the proposal on biodiversity. • The effectiveness of proposed mitigation and management measures. • Consultation with relevant agencies and stakeholders.	Prior to construction and during construction	DECC Restoration and Rehabilitation Guidelines.
Minimise impacts to ground dwelling mammals.	B18	Targeted fieldwork of those areas identified as potential habitat for ground dwelling mammals will be conducted. The fieldwork will aim to develop mitigation and management measures that reduce impacts on these species, including a consideration of lifecycle requirements and breeding times.	Prior to construction	Chapter 9 of the EA
Minimise impacts to Green and Golden Bell Frog and wetland bird species.	B19	Targeted fieldwork in areas identified as potential habitat for these species will be conducted. The assessment will aim to develop mitigation and management measures that reduce impacts on this species, including a consideration of lifecycle requirements, breeding times, and impacts from the spread of Cinnamon Fungus.	Prior to construction	Chapter 9 of the EA
Minimise impacts to Koalas species from disturbance to core Koala habitat.	B20	Areas of potential Koala habitat, will be further assessed to identify whether any areas identified represent core koala habitat. Should areas of core Koala habitat be identified, mitigation and management measures will be developed with consideration for any relevant, in force, plans of management.	Prior to construction	*State Environmental Planning Policy 44 – Koala Habitat Protection*

Objective	Ref #	High level principled commitment	Timing	Reference
Minimise impacts related to the spread of Cinnamon Fungus.	B21	Investigate management measures to minimise the spread of Cinnamon Fungus, taking into consideration: • The outcomes of a risk assessment conducted to determine areas of the ROW where risk of the disease may be high. • Advice gained from liaison with DECC and other relevant government agencies. • Current available initiatives relating to hygiene, and chemical or other control mechanisms.	Prior to construction	Chapter 9 of the EA Commitment reference C3
Aboriginal heritage				
Minimise impacts to known sites of high significance (categorised as high impact sites).	AH1	The ROW will be aligned to avoid the following three sites once the outcomes of an archaeological survey with elders are known: • Euraba Mission Aboriginal Ceremony and Dreaming. • Euraba Mission Burial. • Euraba Whalan Creek Modified (Carved or Scarred) Tree	Prior to construction	Section 10.1.5 of the EA Tables 10.4 and Table 10.5 of the EA Appendix E
	AH2	To the extent to which the location of the known Wallalong Brush Conflict site of high significance can be identified based on information obtained through the oral research with traditional knowledge holders referred to in Chapter 10, the ROW will avoid the site.	Prior to construction	Section 10.1.5 of the EA Tables 10.4 and 10.5 of the EA Appendix E
Minimise potential for accidental impact on sites of low to moderate significance (categorised as low to moderate impact sites)	AH3	Site types and sites categorised as low to moderate impact, where identified during pre construction surveys, will be managed in accordance with the measures indicated in Tables 10.4 and Table 10.5.	Prior to and during construction	Section 10.1.5 of the EA Tables 10.4 and 10.5 of the EA Appendix E
	AH4	All personnel and contractors working on site will receive training in their responsibilities under the *National Parks and Wildlife Act 1974* as part of an Aboriginal heritage induction program. Additional site specific training will be given to workers when working within identified sensitive zones, as per	Construction	Section 10.1.5 of the EA Table 10.4 of the EA Appendix E

Objective	Ref #	High level principled commitment	Timing	Reference
		the predictive model.		
	AH5	A mechanism will be developed to provide for the management of impacts to artefact scatters above a given density. This mechanism will: • State thresholds when works in the immediate vicinity will stop. • Identify relevant project personnel with authority to stop works in the immediate vicinity when the prescribed threshold is reached. • Include provision for verification of significance of the find by the project archaeologist or similar. • Provide a framework for the resolution and management of the find, seeking input from relevant Aboriginal groups, and the DECC.	Prior to construction	Section 10.1.5 of the EA Table 10.4
Minimise impact to other items of high significance.	AH6	Should any items or sites of high significance, including Aboriginal human remains, not previously identified be uncovered during construction, all works in the immediate vicinity of the find will cease. A mechanism will be developed to manage this contingency. Works will not recommence in the areas until appropriate clearance is given; specialist advice will be sought as necessary.	Construction	Section 10.1.5 of the EA Table 10.4 of the EA Appendix E
Conserving high significance sites.	AH7	The strategic approach described in Chapter 10 for identification of potential high significance sites through oral research with traditional knowledge holders will be completed and identified constraints mapped on alignment sheets.	Prior to construction	Section 10.1.5 of the EA Appendix E
Contributing to understanding of indigenous cultural heritage values.	AH8	In relation to impacts on artefact scatters below the threshold identified in AH5, the proponent, in consultation with local Aboriginal stakeholders, will develop a program to undertake in each of the five bioregions one strategic research project to determine cultural heritage significance and provide the outcomes of the research to the local Aboriginal stakeholders	Prior to construction	Section 10.1.5 of the EA Tables 10.4 and 10.5 Appendix E

Objective	Ref #	High level principled commitment	Timing	Reference
		consulted in a form to be agreed.		
Historical heritage				
Minimise impacts on hard and moderate historical heritage constraints.	HH1	Use the heritage assessment to inform the final alignment of the ROW.	Prior to construction	Section 10.2 of the EA. Appendix F
	HH2	Maintain consultation with the Heritage Branch of DoP, local councils and other relevant agencies and stakeholders.	Prior to and during construction	Section 10.2 of the EA. Appendix F
	HH3	Include relevant known and potential heritage constraints in the CEMP.	Prior to and during construction	Section 10.2 of the EA. Appendix F
Minimise impacts on historical heritage items.	HH4	Identify and avoid within the ROW potential hard and moderate heritage constraints based on the predictive model.	Prior to and during construction	Section 10.2 of the EA. Appendix F
Noise and vibration				
Minimise the impact of construction and operation noise and vibration on surrounding residents and property.	N1	Construction noise and vibration management strategies will be outlined in the CEMP. Construction and operation measures will include: • Liaising with community to advise on likely timing and duration of noisy activities. • Resolving complaints received from residents and landowners. • Using noise abatement measures where reasonable and feasible.	Construction and operation	*Environmental Noise Control Manual,* EPA, 1994 *NSW Industrial Noise Policy,* EPA 2000 Chapter 11 of the EA
Minimise impacts of blasting.	N2	Blasting will be carried out in accordance with Australian Standard AS2187.	Construction	AS2187 Chapter 11 of the EA
Minimise the impact of construction and operation noise and vibration on surrounding residents.	N3	Following route finalisation, any potential major noise impacts will be identified and if required specific localised mitigation measures will be developed.	Prior to and during construction	*Environmental Noise Control Manual,* EPA, 1994 Chapter 11 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
				Chapter 18 of the EA
Minimise the impact of blasting.	N4	Areas for blasting will be identified and procedures defined.	Prior to and during construction	AS2187 Chapter 11 of the EA Chapter 18 of the EA
Traffic and transport				
Minimise impact on road networks.	T1	Preparation of crossing plans in consultation with the appropriate road authority.	Construction	AS1742.3 RTA TD 2006-05 Chapter 11 of the EA
	T2	Any oversized or over weight loads will be transported in accordance with NSW RTA requirements.	Construction	*Road Transport (Mass, Loading and Access) Regulations 2005* Chapter 11 of the EA
Minimise impacts on human receptors and local traffic networks.	T3	Specific localised traffic impacts will be assessed following the determination of the location of construction camps, pipeline storage areas, vehicle depots and ROW access points. If there are significant impacts identified then specific transport arrangements associated with pipe transport and storage and construction vehicle movements will be developed to minimise localised impacts on other road users.	Prior to and during construction	Chapter 11 of the EA Chapter 18 of the EA
Air quality				
Minimise reduction in air quality from dust and particulate matter.	A1	Working practices will be managed to minimise nuisance dust.	Construction	Chapter 11 of the EA
	A2	Blasting will be conducted at appropriate times, with consideration of site conditions and sensitive receivers.	Construction	AS2187 Chapter 11 of the EA
	A3	The burning of material on site will be prohibited, except under the instruction of fire services.	Construction	Chapter 11 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
	A4	Vehicles will be maintained to ensure emissions are kept to the minimum practicable.	Construction	Australian Design Rules and relevant manufacturer specifications Chapter 11 of the EA
Containment of gas within the pipeline.	A5	Regular maintenance checks will be undertaken and a leak detection system will be installed.	Operation	AS2885.3 Chapter 11 of the EA
Socio-economic				
Minimise adverse social and economic impacts of access to private property.	SE1	Final route selection across private properties will be conducted in consultation with landowners to minimise impacts during construction and operation of the pipeline.	Prior to construction	Chapter 12 of the EA
Minimise impact of pipeline easement on landowners.	SE2	The proponent will continue negotiations with landowners regarding location of easement, aboveground infrastructure and compensation and terms and conditions of consent.	Prior to construction	Chapter 12 of the EA
Create employment opportunities.	SE3	Strategies will be put in place to maximise employment opportunities for local and indigenous workers (eg working with local employment and training agencies).	Prior to construction	Chapter 12 of the EA
Land use planning				
Minimise land use conflicts.	L1	The detailed pipeline alignment will continue to be refined to avoid land use conflicts, particularly in relation to existing and proposed urban settlements, extractive industries, environmentally sensitive land uses.	Prior to construction	Chapter 3 of the EA Chapter 13 of the EA
	L2	Construction scheduling will be cognisant of avoiding seasonal constraints associated with existing land use activities.	Construction	Chapter 13 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Minimise impacts to agricultural activities.	L3	The proponent will endeavour to negotiate with each landowner terms and conditions relating to construction activities on their land, which may include: • access; • weed management; • crop control in relation to GMO; and • livestock security.	Construction	Section 5.3.13 Section 6.3.4 Section 13.1.1 Chapter 13 of the EA *Noxious Weeds Act 1993*
To avoid adverse impacts on known areas of mine subsidence and to ensure that engineering design is cognisant of relevant constraints.	L4	Further consultation will be undertaken with the Mine Subsidence Board and the DPI (Minerals) in order to continue to review proposed mine expansions that may impact the pipeline.	Prior to construction	Chapter 13 of the EA Chapter 18 of the EA
To avoid land use conflicts.	L5	Further review and route refinements to avoid potential land use conflicts in relation to: • Ardglen Quarry expansion. • Muswellbrook new LEP. • Maitland Urban Settlement.	Prior to construction	Chapter 13 of the EA Chapter 18 of the EA
Hazards and risks				
Minimise the risk of incidents during construction and operation.	H1	The pipeline will be aligned, designed and operated in accordance with AS2885, DoP risk criteria, and required safety management systems.	Prior to, during construction and operation	AS2885. *HIPAP No.4 (DoP, 1992).* Chapter 14 of the EA
	H2	The qualitative and quantitative risk assessments will be updated during the design phase.	Prior to construction	AS2885 *HIPAP No.4 (DoP, 1992).* Chapter 14 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Surface and groundwater				
Adopt appropriate water crossing technique.	W1	The proponent will engage with DECC, DPI and DWE with regard to crossing methods and site specific management measures for high sensitivity watercourse crossings.	Construction	Chapter 15 of the EA *Fish Passage – Requirements for Waterway Crossings, NSW Fisheries*, Fairfull, S. and Witheridge, G, 2003 APIA Code
Minimise changes in waterway channel or bank form.	W2	The proponent will implement all practicable measures to limit impacts on watercourses and channels during construction of the pipeline. Measures to be implemented will be guided by industry and government guidelines and policies.	Construction	*Fish Passage – Requirements for Waterway Crossings, NSW Fisheries*, Fairfull, S. and Witheridge, G, 2003 APIA Code Chapter 15 of the EA
Minimise pollution of surface or groundwater.	W3	Soil and water management measures will be implemented during the construction phase through the CEMP. Management measures will be prepared in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) as appropriate to pipeline construction.	Construction	*Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) *Soil Erosion and Sediment Control Engineering Guidelines*, Institute of Engineers Australia (IEAust, 1996) APIA Code Chapter 15 of the EA
	W4	Trenches will be compacted and reinstated in such a way as to compensate for settling of backfill. Where crowns are used, crown breaks will be created at regular intervals and at drainage lines to permit continued surface water flows and prevent scouring along the trench or ponding.	Construction	APIA Code Chapter 15 of the EA
	W5	A spill response procedure, addressing fuels, lubricants and other chemicals will be outlined in the CEMP.	Construction	APIA Code Chapter 15 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Minimise changes to existing surface and groundwater regimes.	W6	The proponent will implement all practicable measures to limit potential impacts on existing surface and groundwater regimes and this will be documented in the CEMP.	Construction	APIA Code Chapter 15 of the EA
Minimise impacts on water quality and geomorphology.	W7	HDD will be used for the crossing of the Hunter River in the Tomago area.	Construction	APIA Code Chapter 15 of the EA
	W8	Where practicable watercourses will be crossed when they are dry.	Construction	APIA Code Chapter 15 of the EA
Minimise the risk of pollution of surface and groundwater and adverse impact on surface and groundwater bodies.	W9	Any water extraction required for the proposal, will be in accordance with the relevant Water Sharing Plan.	Construction	Relevant Water Sharing Plans under the *Water Management Act 2000* Chapter 15 of the EA
Minimise potential impacts on surface and groundwater.	W10	Further assessment will be undertaken on watercourses identified as being of high sensitivity to finalise crossing locations, methods and site specific management measures.	Construction	*Fish Passage – Requirements for Waterway Crossings, NSW Fisheries*, Fairfull, S. and Witheridge, G. 2003 APIA Code Chapter 15 of the EA Chapter 18 of the EA
	W11	The DPI, DWE and DECC will be consulted on waterway crossing methods and mitigation measures employed for high sensitivity waterways. A profile of the waterway crossing would be provided to DPI, DWE and DECC.	Construction	*Fish Passage – Requirements for Waterway Crossings, NSW Fisheries*, Fairfull, S. and Witheridge, G, 2003 APIA Code Chapter 15 of the EA
	W12	If identified by the relevant landholder, the location of unregistered nearby groundwater bores will be mapped and the pipeline route will avoid these bores.	Prior to construction	Chapter 15 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Infrastructure				
Minimise adverse impacts on other infrastructure during construction and operation.	I1	Stakeholder engagement with infrastructure owners and managers will be ongoing to ensure their requirements for crossings and works in the general vicinity of their infrastructure are implemented during construction and operation.	Prior to construction	*Code of Practice for Work Near Overhead Powerlines*, Workcover, 2006 *Roads Act 1993* Standards of all relevant utilities, including ARTC, Country Energy, Hunter Water, Energy Australia, Transgrid, RTA and Telstra Chapter 16 of the EA
Coordinate multiple infrastructure and service impacts.	I2	A collaborative management approach involving the relevant infrastructure owners/managers will be ongoing to coordinate management measures in areas where multiple infrastructure services are affected.	Prior to construction	Chapter 16 of the EA
Minimise impacts on the pipeline and utilities and infrastructure during maintenance.	I3	Cooperative management approach will be developed with utility or infrastructure providers for maintenance and access arrangements.	Operation	Chapter 16 of the EA
Resource and waste management				
Ensure waste generated is managed appropriately.	RM1	Waste materials will be classified and managed in accordance with the *Waste Classification Guidelines* (DECC, 2008).	Construction	*Waste Classification Guidelines*, DECC, 2008 *POEO Act 1997* Chapter 17 of the EA
Minimise impacts on water resources, erosion and water quality as a result of hydrostatic testing.	RM2	Appropriate water sources for construction activities including hydro-testing will be investigated and identified. Relevant irrigation groups and DWE will be consulted.	Prior to construction	Section 7.2.4. of the EA Chapter 15 of the EA Section 17.1 and Table 17.3 of the EA Chapter 18 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
	RM3	Prior to the commencement of hydro-testing activities, a hydrostatic testing program/procedure will be prepared. This will include measures to address: • Confirming quantity of water extraction. • Preventing/minimising temporary depletion of water resources due to water extraction for hydrostatic testing • Erosion at site of hydro-test water discharge. • Changes to water quality of receiving water environment.	Prior to construction	*Analysis of Hydrostatic Test Water, CMIT Report No: CMIT-2005-259,* 5th December 2005 POEO Act 1997 Chapters 15 and 17 of the EA
Contaminated land				
No significant harm to human health and environment from excavation in contaminated sites.	CL1	Management measures will be prepared as part of the CEMP to outline procedures to review site conditions including potential contaminants and where necessary, outline measures to ensure appropriate action will be undertaken during construction to avoid any potential impacts to the environment or human health.	Construction	*CLM Act 1997* Chapter 17 of the EA
Contamination resulting from accidental spills.	CL2	Site environmental management measures will be developed and outlined in the CEMP with the purpose of minimising the potential for spills to occur and implementing remedial actions.	Construction	Chapter 17 of the EA
Soils and geology				
Manage soils.	S1	Soil types will be identified and delineated along the alignment.	Prior to construction	Chapter 17 of the EA
	S2	Soil management measures will be developed according to soil type and be documented in the CEMP.	Prior to and during construction	Chapter 17 of the EA
Expansive soils.	S3	The depth of expansive soils will be identified and where practicable the pipe installed below the depth of expansive soils.	Construction	*Soil Erosion and Sediment Control Engineering Guidelines*, Institute of Engineers Australia (IEAust, 1996) Chapter 17 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Minimise loss of top soil.	S4	Erosion and sediment management controls will be prepared as part of the CEMP to manage and minimise erosion and control sediment impacts associated with the construction of the pipeline.	Construction	*Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) *Soil Erosion and Sediment Control Engineering Guidelines*, Institute of Engineers Australia (IEAust, 1996) APIA Code Commitment reference W3 Chapters 15 and 17 of the EA
Prevent rising groundwater and salinity.	S4	The proponent will implement all practicable measures to limit any impact the construction and operation of the pipeline may have on rising groundwater and salinity (eg avoid building on the side of hills and extra depth of cover where possible).	Construction	Chapter 17 of the EA
	S5	Options to vegetate the ROW with saline tolerant vegetation would be investigated in consultation with DECC and landholders, where appropriate.	Operation	Chapter 17 of the EA
Minimising impacts of ASS.	S6	ASS management measures will be prepared as part of the CEMP in accordance with relevant industry practice guidelines and procedures.	Construction	*Acid Sulphate Soil Manual*, Acid Sulphate Soil Management Advisory Committee, 1998 Chapter 5 of the EA Chapter 17 of the EA
Minimise impacts to soil.	S7	A targeted geotechnical investigation will be undertaken to map soil constraints.	Prior to construction	Chapter 17 of the EA Chapter 18 of the EA
Visual amenity				
Maintain visual amenity along the ROW.	V1	Areas that are visually sensitive will be identified in the CEMP and revegetation carried out in accordance with the APIA Code.	Operation	APIA Code Chapter 17 of the EA
Maintain visual amenity in the vicinity of aboveground ancillary infrastructure.	V2	Visual amenity will be taken into consideration in the detailed design and location of aboveground infrastructure facilities.	Operation	Chapter 17 of the EA

Objective	Ref #	High level principled commitment	Timing	Reference
Greenhouse gas emissions				
Minimise exhaust emissions from transportation and production.	GG1	Adequate planning and maintenance to ensure efficient use of vehicles.	Construction	Commitment reference A4 Chapter 17 of the EA
Minimise gas leaks.	GG2	Continuous monitoring system to detect leaks and a maintenance program to minimise fugitive emissions.	Operation	Chapter 17 of the EA Chapter 5 of the EA
Minimise gas releases.	GG3	Practicable measures will be implemented to minimise planned releases for maintenance work.	Operation	Chapter 17 of the EA
	GG4	Pipeline maintenance and safety measures (eg signage) to minimise the risk of accidental gas releases.	Operation	AS2885 Chapter 17 of the EA
Adaptive management of environmental constraints				
Minimise serious or irreversible environmental damage.	AM1	The design philosophy for the management of further identified environmental constraints will adopt a hierarchy of: • Avoid. • Mitigate. • Offset.	Prior to construction	Chapter 18 of the EA
Ensure adaptive management of environmental constraints.	AM2	The proponent will carry out the fieldwork referred to in Table 18.1	Prior to construction and construction	Chapter 18 of the EA Table 18.1

20 Proposal justification and conclusion

20.1 Introduction

This EA has been prepared to consider the potential impacts of the construction and operation of the proposed QHGP, which will deliver gas from the Queensland border to Newcastle. It provides an assessment of the potential environmental impacts of the project while considering and recommending management and mitigation measures to protect the environment through which the Study Area passes.

The EA has been prepared in accordance with Part 3A of the EP&A Act. It demonstrates that the project is consistent with broader state objectives by contributing to increased business investment, jobs creation and the achievement of broader environmental goals including the security of gas supply and the cost effective provision of a cleaner energy source for the NSW market.

To that end, the EA has examined a number of issues in detail relating to the QHGP, including:

- Biodiversity impacts.
- Heritage impacts (Aboriginal and historical heritage).
- Infrastructure impacts.
- Surface and groundwater impacts.
- Human amenity impacts, relating to noise and vibration, air quality and traffic.
- Socio-economic impacts.
- Land use planning impacts.
- Hazard and risk impacts.

The route selection process and construction methodology detailed in Chapters 3 and 5 of this EA have been developed to minimise any potential impacts of the QHGP. Results of the assessments into other key issues indicate that potential impacts are likely to be relatively contained and more predominant during the construction phase of the project. The draft SoCs included with this assessment outlines measures to manage these impacts.

The *EP&A Regulation 2000* outlines the requirements of an environmental assessment, including the reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ESD. This chapter specifically justifies the project against these assessment criteria.

20.2 Biophysical considerations

The potential biophysical impacts associated with the proposed project have been assessed in Chapter 9. Consideration of impacts on biophysical environment continues to be fundamental to the ongoing design process, and accordingly vegetation impacts have, to this point, been avoided as far as possible. Nonetheless, the proposal would likely result in the removal of vegetation identified as potentially representing a number of EECs, and potential direct and indirect impacts to a number of listed threatened species. Opportunities to further reduce these impacts would be explored following the outcome of targeted biodiversity fieldwork. Initiatives directed at offsetting the residual impacts on biodiversity would be considered in consultation with relevant government agencies and other stakeholders.

The QHGP may result in limited impact to watercourses where crossings are necessitated. However, as outlined in Chapter 15 of this EA, mitigation measures including tailoring of construction techniques and management to the nature of the crossing are aimed at limiting temporary and ongoing disturbances to surface water resources.

The assessment of the impact of the proposed development on each of the biophysical elements of the environment has concluded that provided the management measures and monitoring systems are implemented to mitigate potential impacts, the proposed project would not have a significant impact.

Part 3A of the EP&A Act requires that environmental mitigation, management and monitoring requirements be outlined in a statement of commitments, which is included in Chapter 19.

The QHGP is considered to be justifiable in terms of the biophysical elements of the environment through which it passes.

20.3 Social considerations

The potential social impacts of the proposed project are outlined in the human amenity and socio-economic chapters of this EA. Consideration of issues raised by the community during an extensive consultation program, which included a project roadshow to the communities through which the QHGP passes, are included in the community and stakeholder consultation chapter, Chapter 6. Issues raised in the consultative program include:

- Impacts and access to private property during the construction and ongoing operation of the proposed pipeline.
- Noise and traffic impacts.
- Impacts on privacy.
- Compensation and compulsory easement acquisitions.
- Spread of weeds or agricultural diseases.
- Location and types of endangered ecological communities located within the Study Area.
- Management of environmentally significant and vulnerable river and creek areas.
- Potential impact on Aboriginal heritage.
- Environmental impacts and rehabilitation of land and weed control following construction.
- Potential benefits and employment for local areas.
- Ongoing consultation.

Many of these issues correlate with biophysical and economic impacts of the project. It has been concluded within this EA that the QHGP would not have a significant impact provided mitigation measures are implemented, and that the pipeline is justifiable on biophysical and economic grounds.

Issues raised by the community and stakeholders during the consultation program are based on the perception of the QHGP operation and its likely impacts. This EA demonstrates that the project proponent has endeavoured to address all concerns raised by the community and stakeholders, particularly those potential long-term impacts related to land tenure and loss of land productivity and shorter-term impacts such as noise generated during construction.

On balance, the QHGP is not considered to have significant social impacts on the communities through which it will pass, given its alignment with respect to sensitive receptors and design and management mitigation measures to be implemented in accordance with the SoCs. It is considered that the project is therefore justifiable on social grounds.

20.4 Economic considerations

The socio-economic assessment outlined in Chapter 12 demonstrates that the QHGP will provide both direct and indirect economic benefits to the local, regional and state economies during construction and ongoing operation. In particular, the construction phase of the QHGP will generate employment opportunities and income to local businesses along the Study Area as the construction teams pass through these regions and will result in a direct capital investment of up to $600 million in the State.

Direct economic benefits in the form of local employment opportunities during construction and in the finishing and haulage of materials used in the construction of the pipeline will be realised. In addition, indirect benefits through activities such as increased business activity generated by the supply of gas to unserviced businesses will also be realised. Overall, it is estimated that around 600 jobs would be created during the construction period. Most of these roles will be for pipeline specialists, however there may also be opportunities for local and indigenous labour to work on certain aspects of the pipeline construction, for example clearing and grading of land.

It is estimated that around 25 permanent jobs would be created in the areas of operation and maintenance. These jobs would include activities such as conducting regular inspections of the pipeline easement either by ground vehicle or by aircraft and the carrying out of repairs.

The QHGP will also generate broad economic benefits to the state estimated by ANZIS (ANZ Infrastructure Services, 2007). Investment flows that may result for the pipeline include:

- Expansion of aluminium smelters in the Hunter Region – around $1,080 million.
- Development of an 800MW gas fired power station – around $680 million.
- Development of CSG exploration and production in north east NSW – around $100–200 million.

Given the direct and indirect benefits associated with the construction and operation of the pipeline, the proposed project is justifiable on economic grounds.

20.5 Ecologically sustainable development

The *Protection of the Environment Administration Act 1991* defines ESD as being achievable through the implementation of the following principles:

- The *precautionary principle*, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
  - Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment.
  - An assessment of the risk-weighted consequences of various options.
- *Inter-generational equity*, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
- *Conservation of biological diversity and ecological integrity,* namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.
- *Improved valuation, pricing and incentive mechanisms,* namely, that environmental factors should be included in the valuation of assets and services, such as:
  - Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement.
  - The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.
  - Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The following sections evaluate the QHGP against the abovementioned principles of ESD.

20.5.1 Precautionary principle

The assessment of the potential impacts of the QHGP is consistent with the precautionary principle. The assessment of key environmental impacts presented throughout this EA is consistent with robust scientific and professional methodologies. As noted, consultation with key stakeholders has also been undertaken to feed directly into the assessment process with a view to further defining potential impacts and mitigation measures.

These investigations have identified a number of potential impacts of the proposal on the local or regional environment. Where impacts have been identified, a number of management measures have been nominated to reduce or remove the impacts. It is expected that management and mitigation measures proposed in Part B will principally manage adverse impacts during both the construction and operational phases. However, it should be noted that for some issues, these measures will also need to be supplemented by the outcomes of fieldwork identified in Chapter 18. The fieldwork requirements are considered necessary due to current uncertainty on the magnitude of impacts for some issues in the Study Area, and demonstrate a precautionary approach to both the identification of potential impacts, and the development of management strategies.

20.5.2 Intergenerational equity

The assessment of the QHGP has identified no significant impacts associated with the operation or construction of the pipeline that lead to long-term environmental degradation. The potential for long-term impacts to be generated by the QHGP has been minimised by the application of mitigation measures and through careful route selection which aimed to:

- Provide gas to Newcastle and strategic locations in northern NSW.
- Take into account potential CSG developments in northern NSW.
- Service potential markets in the HEZ and other areas not presently served with gas.
- Achieve an economically and environmentally feasible route for construction.
- Provide a safe operable pipeline taking into consideration environmental, access, stakeholder and cost impacts.
- Satisfy principles of ESD.
- Identify regional constraints, including topographic, heritage and environmental, within the 200km Study Area.
- Identify potential general routes within the 200km starting Study Area taking into account the identified regional constraints, potential gas supply and demand locations and constructability.
- Qualitatively and quantitatively assess the general route options based on criteria that were aligned to the objectives for the proposed pipeline route.
- Conduct a comparative assessment of each of the general route options, against each other, in relation to the quantitative criteria.
- Select a preferred general route option based on a review of the comparative analysis.

20.5.3 Conservation of biological diversity and ecological integrity

The Study Area for the QHGP has been selected to ensure that there is minimal impact on the local biological diversity and ecological integrity of the areas through which the proposed pipeline will pass. Specialist studies conducted as part of the EA have identified that there is potential for a number of direct and indirect impacts to threatened species, populations and communities, as a result of the proposal. Accordingly, and as part of the ongoing refinement of the proposal, the ROW would be further investigated to avoid impacts on local biodiversity features, wherever possible. In addition, specific measures have been designed to appropriately manage biodiversity impacts, and where these impacts cannot be adequately mitigated, QHGP is proposing to develop a comprehensive offset strategy that would contribute to the long-term conservation of biodiversity.

20.5.4 Improved valuation of environmental resources

This EA has identified the environmental and other consequences of the proposal and identified mitigation measures where appropriate to manage adverse impacts. Construction and operation of the QHGP would be required to be in accordance with relevant legislation and any construction and operational management plans for the pipeline that may be prepared prior to construction commencing.

Requirements imposed on the proponent, construction contractors and operator of the pipeline in terms of implementing proposed management measures represent a cost to the project. The implementation of these measures may also increase the capital and operating costs of the QHGP, indicating that environmental costs have been valued in the assessment process.

The QHGP is also proposing to develop an offset strategy, consisting of a set of actions that could be implemented to offset any residual biodiversity impacts from the proposal. It is anticipated that through fieldwork and consideration (including consultation with relevant government agencies and stakeholders) these actions would form the adopted offset strategy for the QHGP. The objectives of the final strategy would be to offset the residual impacts of the proposal on biodiversity, particularly on impacted EECs and habitat for threatened species, so as to ensure an improvement in biodiversity values in the area in the long term.

20.6 Consequences of not proceeding

The proposed QHGP will provide a vital missing link in the eastern Australian gas transmission grid. It will serve to connect the NSW gas market to world-class reserves of CSG in Queensland providing additional diversity of supply to that already sourced from Gippsland and the Cooper Basin. There are a number of significant consequences for the state should the QHGP not proceed. They include:

- The potential for adverse impact on the NSW economy of significant power service interruptions resulting from a catastrophic failure of the existing distribution network. This could include loss of income, decreased productivity and higher maintenance costs. The eastern Australian gas market has suffered from two such events in the last decade resulting in significant economic impact.
- The potential for service interruptions to interruptible commercial customers as higher priority customers such as residences and hospitals are connected to the gas network. This occurred during the recent load shedding event and future events are likely to particularly affect the Newcastle and Hunter areas as present supplies of gas dwindle and more customers are added to the market.
- The risk to long-term supply of the NSW gas market posed by dwindling reserves in the Cooper Basin in South Australia particularly the impact of increased delivered gas prices on the NSW economy resulting from narrow diversification of supply and increases in demand for gas.
- The loss of economic growth, including temporary and permanent employment that would be generated by the construction and operation of the pipeline and the loss of economic benefit derived from private sector investment in electricity generation and industry resulting from a lack of a secure and affordable supply of gas to the Hunter and Newcastle regions.
- The loss of potential economic benefit that may be derived from the further exploration and commercial production of CSG reserves in the north of the state.
- Reduced potential for further investment in gas-fired peaking and base load power generation to meet predicted increases in demand for electricity by 2013–14.

20.7 Conclusion

In conclusion, it is considered that the proposed construction and operation of the QHGP will assist in meeting broader economic goals of the NSW Government as outlined in the NSW State Plan and associated policies such as the State Infrastructure Strategy and Lower Hunter Regional Strategy. In particular, the proposed QHGP is a strategic piece of critical infrastructure serving the eastern Australian gas market and providing a missing link in the existing east coast distribution network.

This EA has endeavored to address the potential environmental impacts of the proposed QHGP during construction and operation of the pipeline. The iterative development of avoidance, mitigation and management measures has also been a key feature in the preparation of this environmental assessment. Firm commitments to implement mitigation measures and undertake fieldwork have been made in the SoCs.

On balance, the weight of benefits to the NSW and the eastern Australian gas market associated with the QHGP are compelling while every effort has been made to limit impacts on the communities and environment through which the pipeline will pass.

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22 Glossary and abbreviations

22.1 Glossary

Term	Definition
AC corrosion	Corrosion of metal (pipe) due to alternating current induction near powerlines.
Acid sulphate soils	Soils containing iron sulphides that, when exposed to air, may oxidise and produce sulphuric acid.
Acidic peat	An accumulation of partially decayed vegetative matter that has an acidic nature.
Alignment	The location of the pipeline underground.
Alluvial	A landscape feature that was formed by a river or stream.
Anthropogenic	Human made or synthesised.
Arboreal	Species that live predominantly in trees.
Avifauna	Bird species
Base load	The minimum level of demand on a specific power supply system during a 24 hour period.
Bentonite	An absorbent, colloidal clay mainly composed of montmorillonite.
Berm	A level space or raised barrier such as a mound of soil, that separates two areas, usually created for a specific purpose.
Biocide	Additive to prevent the formation and growth of micro-organisms.
Bio-corrosion	The biological decay of metal.
Bioregion	A region defined by its biophysical characteristics, as identified by Thackway and Creswell (1995).
Blasting	Rock removal through the use of explosive charges.
Boring	Describes the act of drilling, usually in a horizontal direction.
Bore-water	Water sourced from underground, also called groundwater.
Carbon dioxide equivalent ($CO_{2\text{-}e}$)	The amount of carbon dioxide in a mixture that would have the same global warming potential when measured over a certain timescale. It is calculated by multiplying the unit of gas by the global warming potential.
Cathodic protection	A system of preventing corrosion that includes the use of direct current induction.
Chain trencher	A vehicle or plant used to dig trenches by using a digging chain.
Coffer dam	A watercourse crossing method that involves the installation of temporary dams.
Corridor	An area for purpose of this study within which the pipeline alignment

Part C

Term	Definition
	would be situated or a linear feature around a centreline.
Critical infrastructure	A major infrastructure project that is considered by the New South Wales (NSW) Minister for Planning to be essential to the State for economic, social or environmental reasons, thence gazetted as a "critical infrastructure" project under the *Major Projects State Environmental Planning Policy* 2005.
Dam and pump	A watercourse crossing method that involves the installation of a dam upstream of the crossing so that water can be pumped around the crossing location.
Deep ripping	A process that involves the breaking up of soil below the uppermost layers. Also known as blade ploughing.
Director General's Requirements (DGRs)	The required considerations and inclusions for an Environmental Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979*, and as outlined in documentation put forward by the Director General from the NSW Department of Planning.
Drilling slurry	A water based bentonite used in horizontal directional drilling.
Easement	A right legally possessed by the Proponent to use an area that will be designated for the installation and operation of a pipeline.
Ecologically Sustainable Development (ESD)	A form of development that involves the utilisation and conservation of natural resources so the ecological processes are maintained or enhanced for both current and future generations as defined by the *Protection of the Environment Administration Act, 1991*.
Edge effects	Impacts resulting from the fragmentation of ecosystems and the reduction of habitat boundaries.
Endangered Ecological Communities (EECs)	An ecosystem that has been identified as endangered or threatened, as defined in the *Environment Protection and Biodiversity Conservation Act, 1999*.
Ephemeral	Temporary state or condition in nature; such as wetlands during the wet season.
Epoxy material	Materials that react when mixed with a catalysing agent.
Expansive soil	Soils that contain clay and may expand when wet.
Fauna egress point	Section in the trench where trapped fauna can exit.
Fauna entrapment	The unintentional trapping of fauna within the corridor area.
Fine bedding material	Fine material formed after upper soil layers have been disturbed.
Flume	A watercourse crossing method that involves the crossing to be sealed off on both upstream and downstream sides, and water flow diverted around the crossing through a flume or pipe.
Fossorial	Description of species that live underground.
Fusion bonded epoxy (FBE)	A type of powder coating applied by an electrostatic charge to engineering material.
Geodata	GIS data from the Commonwealth of Australia (Geosciences, Australia, 2003)
Geotechnical	Describes or categorises an object, issue or study as primarily associated with the nature of geological materials.

Term	Definition
Grader	A machine with an adjustable blade used to cut, move and spread topsoil into the shape required.
Horizontal directional drilling (HDD)	Drilling a hole at a shallow angle through which a pipe is threaded. Employed in generally silty or gravely soil conditions, such as under a watercourse.
Human amenity	The human/community use and enjoyment of resources within public or privately owned property.
Hydrostatic testing	A method used to identify any leaks within the pipeline.
Inter-generational equity	The maintenance or enhancement of the health, diversity and productivity of the environment for the benefit of future generations as defined by the *Protection of Environment Administration Act, 1991.*
Isolation valves	A type of valve used to separate the fluid media from the inner workings of the valve.
Lateral	A smaller diameter sized pipe that extends from the main pipeline to service a particular area or operation.
Liquefied natural gas (LNG)	The liquid form of natural gas usually produced for easier transportation or storage.
Load shedding event	An occurrence that involves the elimination of customer demand from a power system due to an uncommon condition, so that the performance and integrity of the system is maintained.
Mainline	The portion of the pipeline (approximately 820km) that transmits gas from Wallumbilla, Queensland to Newcastle, NSW.
Major infrastructure	A particular development or development type defined within either the NSW *State Environmental Planning Policy (Major Projects), 2005* or an order by the Minister of Planning published in the NSW Government Gazette.
Metamorphic	Describes materials (such as rocks) that have been altered (in form) through metamorphism.
National Emissions Trading Scheme	A proposal put forward by the Australian Federal Government to assist in reducing greenhouse gas emissions as a response to climate change.
Non destructive testing (NDT)	Describes a testing procedure that does not damage or destroy the test item.
Noxious weed	A type of plant that is to be legally controlled or removed under the *NSW Noxious Weed Act 1993*. Species lists vary depending on the local government area.
Offtake	A potential connection point to the gas pipeline that would enable potential future use of the gas.
Open cut	A watercourse crossing method that involves establishing a stable working platform on either side of the watercourse and creating a trench using excavators.
Open trench	A watercourse crossing method that involves an exposed long depression or cut in the ground.
Oxygen scavenger	A type of chemical that can reduce the amount of oxygen.
Perennial	A watercourse or water body that flows all year round.

Term	Definition
Pigging	A special method that utilises either magnetic flux loss or ultrasonic method for the purpose of identifying any defects within the pipeline.
Precautionary principle	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation as defined by the *Protection of the Environment Administration Act, 1991*.
Proponent	The company that has put forward the proposal for development, in this instance, Queensland Hunter Gas Pipeline Pty Ltd.
Proposal	A natural gas pipeline from near Wallumbilla in Queensland to Newcastle in NSW, including all structures and activities associated with its construction and operation.
Purging	Describes the process in which air is removed from the pipeline prior to the introduction of gas to ensure safe entry of the gas.
Queensland Hunter Gas Pipeline (QHGP)	The name given to the proposal.
Right of way (ROW)	The area required for construction of the pipeline.
Riparian	Describes vegetation along watercourses.
Rocksaw	An engineering tool used to eliminate large material and/or create narrow depressions.
Route	The course or track where the proposed pipeline is to follow.
Saxicolous	Description of species that live in rocky habitats.
Sclerophyll	Describes a vegetation community that is dominated by woody plants that have hard leaves and short internodes. Dominant vegetation in Australia.
Scraper stations	Structures that allow the insertion and/or retrieval of devices to clean the internal sections of the pipe or to detect damage or metal loss within the pipe.
Socio-economic	Describes the impacts or issues upon both society and the economy.
Spoil	Soil material, produced after an excavation.
Spread	A suite of construction activities undertaken in sequence
Strahler System	A system for determining the hierarchy of watercourses.
Stringing	The laying out of the pipe in preparation for welding.
Study area	A 200 metre wide corridor that is the area of assessment. A 30 metre wide ROW will be defined within the study area.
Subsoil	Describes the soil layer that is situated directly beneath the topsoil layer.
Supervisory control and data acquisition (SCADA)	The formal process that monitors the pipeline operation from the control centre.
Terrain pinch point	The point where the pipeline is constrained to go through a certain area.
Third party activity	Any activity that has been performed or carried out by an outside group that has no direct linkage to the QHGP project.

Term	Definition
Topographic	Describes or categorises an object, issue or study as primarily associated with local detail such as relief/elevation, vegetation and anthropogenic features.
Travelling stock route (TSR)	The pathway used by travelling stock as defined in the *Rural Lands Protection Act, 1998*.
Trench	A pipeline installation method that involves an exposed linear depression or cut in the ground.
Visual amenity	The visual and aesthetic quality of a public or privately owned property.
Wobbe index (WI)	A primary indicator of the interchangeability of fuel gases.

22.2 Abbreviations

Abbreviation	Definition
4WD	Four wheel drive
AC	Alternating current
AGO	Australian Greenhouse Office
AHIMS	Aboriginal Heritage Information Management System
AHMS	Archaeological and Heritage Management Solutions Pty Ltd
ANPC	Australian Network for Plant Conservation
ANZ	Australia and New Zealand
ANZECC	Australian and New Zealand Environment Conservation Council
ANZIS	ANZ Infrastructure Services
APIA	Australian Pipeline Industrial Association
ARTC	Australian Rail Track Corporation
AS2885	Australian Standard 2885
ASS	Acid sulphate soils
AUF	Autonomous unmanned aircraft
CANRI	Community access to natural resources (NSW)
CEMP	Construction environment management plan
CLM Act	*Contaminated Lands Management Act 1991*
CMA	Catchment Management Authority (NSW)
CMIT	CSIRO Manufacturing and Infrastructure Technology
CO_2 e-	Carbon dioxide equivalent
CP	Cathodic protection
CSG	Coal seam gas

Abbreviation	Definition
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DC	Direct current
DECC	Department of Environment and Climate Change (NSW)
DGRs	Director General requirements
DoP	Department of Planning (NSW)
DNR	Department of Natural Resources
DPI	Department of Primary Industries (NSW)
DRB	Darling Riverine Bioregion
DWE	Department of Water and Energy (NSW)
DEWHA	Department of Environment, Water, Heritage and the Arts
EA	Environmental assessment
EEC	Endangered ecological community
EGP	Eastern Gas Pipeline
EIA	Energy Information Association
EIS	Environmental impact statement
EMP	Environmental management plan
EP&A Act	*Environmental Planning & Assessment Act 1979*
EPA	Environment Protection Authority (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ER	Environmental representative
ESD	Ecologically sustainable development
FAQs	Frequently asked questions
FBE	Fusion bonded epoxy
GIS	Geographic information systems
Gj	Gigajoule
GMO	Genetically modified organism
GWh	Gigawatt hour
ha	Hectares
HDD	Horizontal direction drilling
HEZ	Hunter Economic Zone
HIPAP	Hazardous Industry Planning Advisory Paper
kg	Kilogram
km	Kilometre
KP	Kilometre point
L	Litre

Abbreviation	Definition
LEP	Local Environment Plan
LGA	Local government area
LNG	Liquefied natural gas
m	Metre
m^2	Square metre
MJ/m^3	Megajoule per cubic metre
ML	Megalitre
MLV	Mainline valve
mm	Millimetre
mm/s	Millimetres per second
Mpa	Megapascal (unit of pressure)
MPs	Members of Parliament
MSDS	Material safety data sheet
MW	Megawatt
NCIG	Newcastle Coal Infrastructure Group
NDT	Non-destructive testing
NES	National environmental significance
NP	National Park
NR	Nature Reserve
NSW	New South Wales
NSWGH Plan	New South Wales Greenhouse Plan
OEMP	Operation environment management plan
OH&S	Occupational health and safety
PEA	Preliminary environmental assessment
PJ	Petajoule
PJ/a	Petajoule per annum
PoEO Act	*Protection of Environment Operations Act 1997*
PPR	Preferred project report
psi	Pounds per square inch
QHGP	Queensland Hunter Gas Pipeline
QRA	Quantitative risk assessment
RLPB	Rural Lands Protection Board
RLMS	Resource and Land Management Services Pty Ltd
ROW	Right of way
ROTAP	Rare Or Threatened Australian Plants

Abbreviation	Definition
RTA	Roads and Traffic Authority (NSW)
SBB	Sydney basin bioregion
SCADA	South West Queensland Pipeline
SEPP	State environmental planning policies
SHR	State Heritage Register
SRB	Sulphate reducing bacteria
SWQP	South West Queensland Pipeline
TJ	Terajoule
TSP	Total suspend particulate
TSR	Travelling stock route
TTPA	Traffic and Transport Planning Associates
UHF/VHF	Ultra high frequency/very high frequency
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
WI	Wobbie Index
WMP	Weed management plan