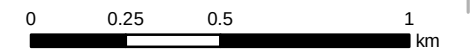


YOUNG - WAGGA WAGGA PIPELINE SECTION 2
Receptors and Construction Noise Map

Source: LPMA (2010), StreetPro (2009)



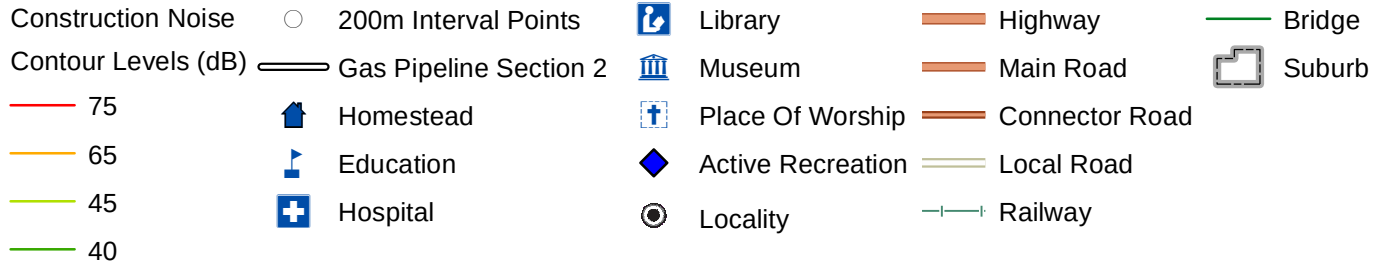
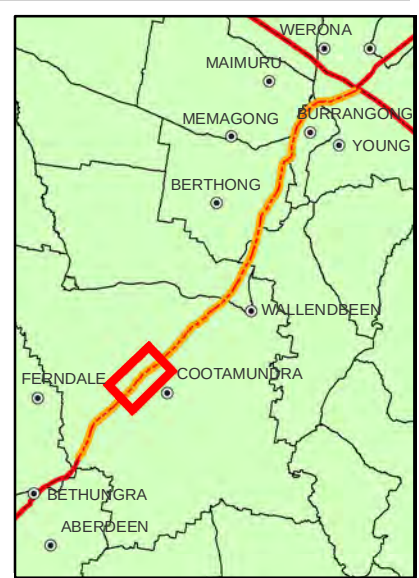
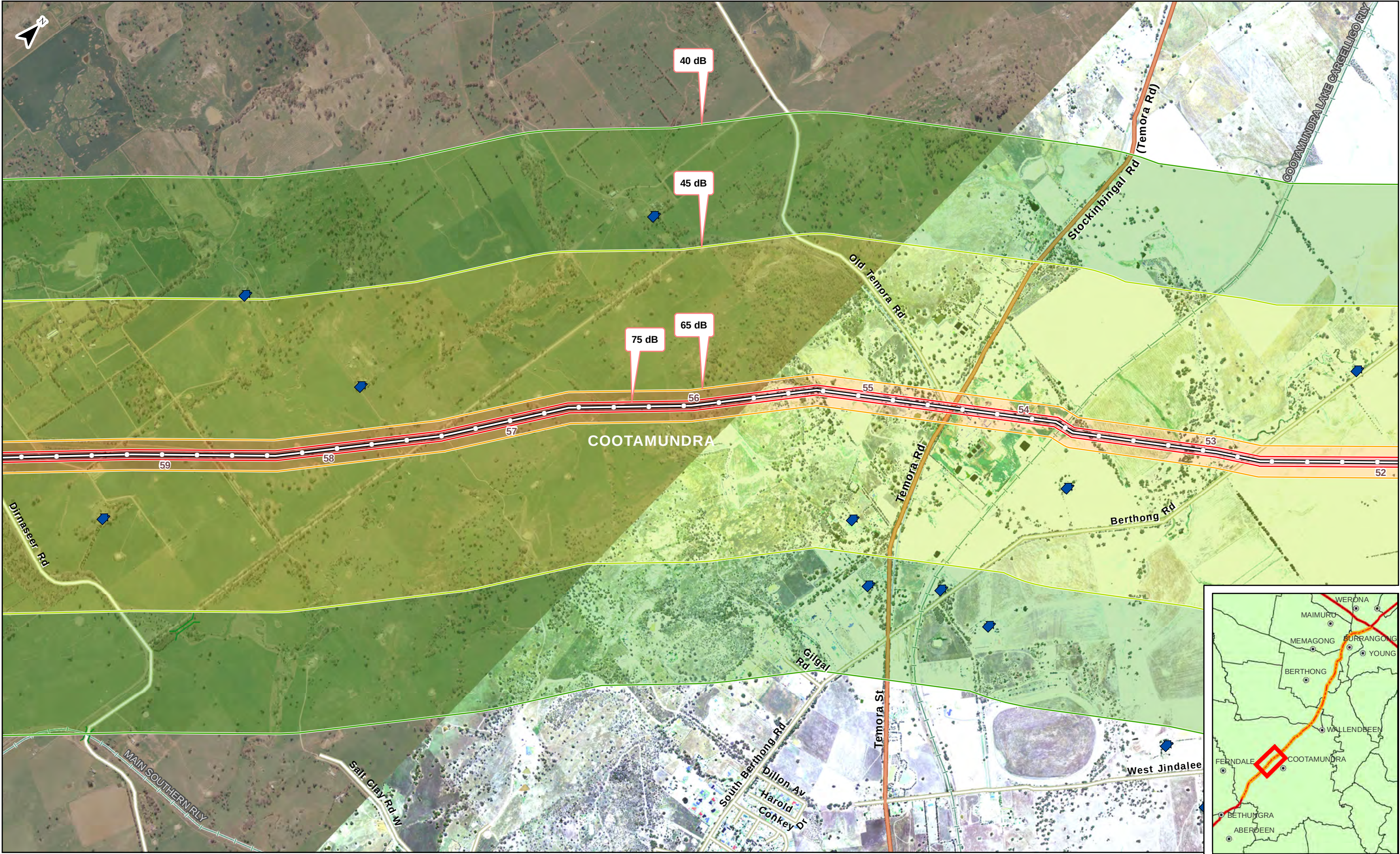
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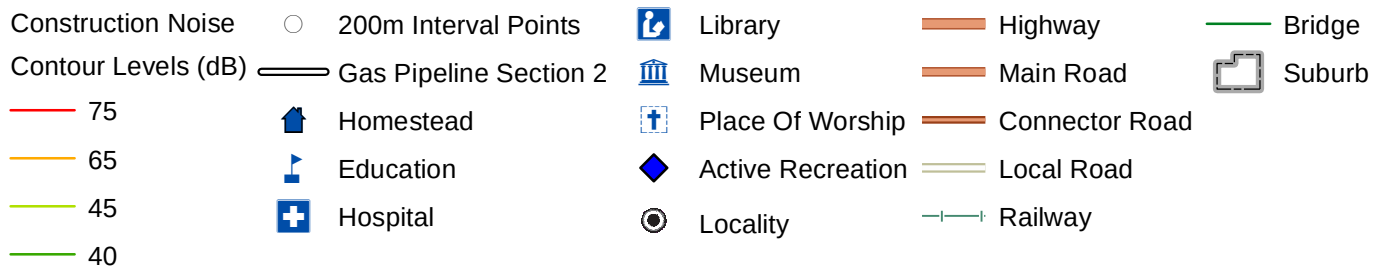
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Fig 12G

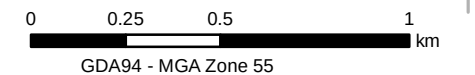
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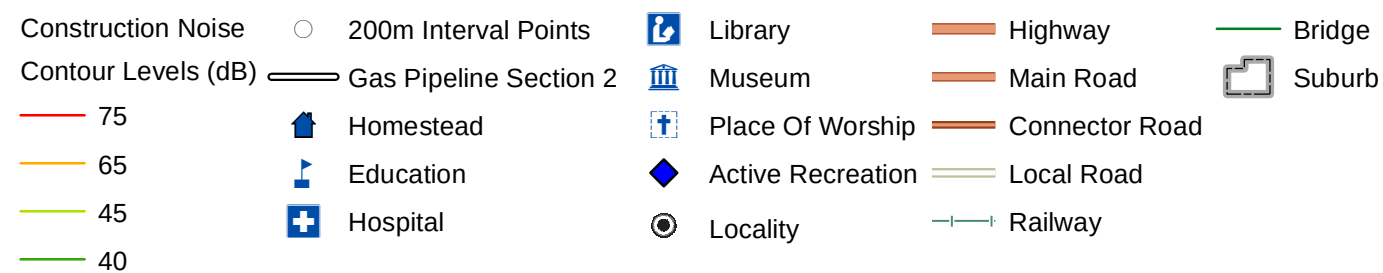
YOUNG - WAGGA WAGGA PIPELINE SECTION 2
Receptors and Construction Noise Map

Source: LPMA (2010), StreetPro (2009)



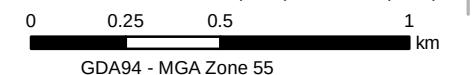
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Fig. **121**



YOUNG - WAGGA WAGGA PIPELINE SECTION 2
Receptors and Construction Noise Map

Source: LPMA (2010), StreetPro (2009)



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Fig. **12J**

10.2.4 Potential Impacts – Noise

Noise – Construction

Noise from pre-construction studies have been considered negligible as it will involve a small number of vehicles and no equipment likely to generate noise. To assess potential impacts, maps representing receptors and offset distances are presented in Figure 12.

While there are 55 receptors within distance of perception (“noise affected”), there is no receptor located within the “highly noise affected” offset distance. Furthermore, none of the sensitive receptors (e.g. classroom and places of worship) will experience the management levels outlined in the Interim Construction Noise Guideline, 2009.

Table 19 – Effected noise receptors

Receptors	Off-set criteria	Details
Residences	Noise affected / 40 dB	55
	Highly noise affected / 75 dB	None
Sensitive receptors	45 dB/65 dB	None

Based on the small number of residences that may be affected by the Proposal, and the fact that no residences are likely to be highly noise affected, it is proposed that the Proposal be constructed in line with standard onshore pipeline practices. Specifically, works are proposed to run in continuous construction cycles. The pipeline will be built using a progressing spread technique with start to finish at most receptor locations to be passed by progressive stages each lasting a couple of days. APA previously worked proactively with landholders on the first stage of the looping pipeline (from Wagga Wagga to Bethungra) to successfully enable similar construction arrangements. APA would utilise an existing freecall 1800 telephone number to enable any landholders that might be affected by construction noise to liaise directly with APA, so that an appropriate resolution can be arranged. Given the awareness of landholders about the proposal (see Section 5.1.4) it is expected that these arrangements would be suitable during this second stage of construction.

Noise – Operation

The only sections where noise impacts associated with the pipeline might be significant are where the pipeline is above the ground (valves). The line valves put in place for the duplication of the pipeline will generate noise during maintenance procedures (once every six months for one hour) and during any emergency procedures. Furthermore, the line valves will be located next to the line valves on the existing operating pipeline and therefore will not represent a new location as source of noise. The noise associated with operation of the pipeline can be considered as marginal and is unlikely to affect significantly any receiver.

10.2.5 Vibration Criteria

Vibration can be defined as regularly repeated movement of a physical object about a fixed point. The parameter normally used to assess ground vibrations is the peak particle velocity (ppv) expressed in millimetres per second (mm/s). The usual thresholds for visibly detect movements of susceptible moving parts is around 0.5 mm/s and the audible rattling of non secured objects usually occurs when level of 0.9 mm/s are reached. Typical construction work and traffic has a frequency range between 8 Hz to 100 Hz. Based on previous monitoring experience, some typical ground vibration level associated with construction activities are shown in Table 20 and perception level for human are shown in Table 21.

Table 20 – Typical ground vibration level associated with construction activities

Construction Activity	Typical Ground Vibration Level
Vibratory roller	Up to 1.5 mm/s @ 25m – higher levels can occur but no damages are expected for building at distance greater than 12m.
Hydraulic rock breakers (typical level for a large rock breaker operating in hard sandstone)	4.5 mm/s @ 5m 1.3 mm/s @ 10m 0.4 mm/s @ 20m 0.1 mm/s @ 50m
Compactor	20 mm/s @ 5m 2 mm/s @ 15m

Construction Activity	Typical Ground Vibration Level
	<0.3mm/s @30m
Bulldozer	1-2 mm/s @ 5m 0.1 mm/s @ 50m
Truck traffic (smooth surface)	<0.2 mm/s @ 20m
Truck traffic (rough surface)	<2 mm/s @ 20m

Table 21 – Human perception of vibrations

Vibration level	Degree of perception
0.10	Not felt
0.15	Threshold of perception
0.35	Barely noticeable
1.0	Noticeable
2.2	Easily noticeable
6.0	Strongly noticeable

Vibration intensive activities such as the use of hydraulic hammers must be operated such as to minimise disturbance to the occupants of buildings and avoid the risk of damage to buildings and other structures.

The German Standard DIN 4150-Part 3 'Structural vibration in buildings – Effects on Structures' provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration. If cosmetic damage is avoided then structural damage will not occur. The OEHW's publication *Assessing vibration: A Technical Guideline* recommends safe working distances to minimise disturbance to occupants of nearby buildings and is based on *British Standard BS 6472:2008 'Guide to evaluation of human exposure to vibration in buildings'*.

Safe working distances for typical vibration inducing equipment are listed in Table 22 below.

Table 22 – Examples of safe working distances for typical vibration intensive plant

Plant	Rating/Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Vibratory Roller	< 50 kN (Typically 1-2t)	5m	15-20 m
	< 100 kN (Typically 2-4t)	6m	20 m
	< 200 kN (Typically 4-6t)	12m	40 m
	< 300 kN (Typically 7-13t)	15m	100 m
	> 300kN (Typically 13-18t)	20m	100 m
	> 300 kN (> 18 t)	25m	100 m
Small Hydraulic Hammer	(300 kg – 5-12t excavator)	2m	7 m
Medium Hydraulic Hammer	(900 kg – 12-18t excavator)	7m	23 m
Large Hydraulic Hammer	(1,600 kg – 18-34t excavator)	22m	73 m
Vibratory Pile Driver	Sheet piles	2–20m	20 m
Pile Boring	≤ 800 mm	2m	N/A

Plant	Rating/Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Jackhammer	Handheld	1m nominal	Avoid contact with structure

10.2.6 Potential Impacts – Vibration

Vibration – Construction

Typical ground vibration levels from construction activities could be up to 20 mm/s at a distance of approximately 5 m. At distances greater than 20 m, vibration levels would usually be around 0.4 mm/s. Because of safety criteria for pipelines there are no receptors within 5 m of the pipeline. Therefore, the expected vibration levels from normal construction activities would not cause structural damage to buildings. Using the maps from the noise section with the 65 dB offset distance (≈ 60 m), no receptor reach the “barely noticeable” degree of perception for vibrations.

Vibration – Blasting

Blasting would be required for trench excavation in areas of hard rock that cannot be rock sawed. Hard rock is present for approximately 2 km of the pipeline route. At this stage of assessment, blasting is anticipated through a number of areas where hard rock is outcropping.

Vibration levels for blasting are higher than that of normal construction activities. Potential impacts to buildings during blasting through vibration or stray debris may include structural damage. Damage could potentially include 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:

- NSW 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.

General recommendations for overpressure (air blast) are limits of 115 dB (peak) at receivers and that ground-borne vibration is limited to a maximum level of 5 mm/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 250 m (using the criterion of 115 dB airblast and 5 mm peak particle ground velocity). This has been taken into consideration in selecting the route through hard rock areas.

Within this zone, there are no residences or receivers likely to be affected based on the assessment of human receptors within proximity of the Proposal.

Vibration – Operation

No vibration is expected to be generated as a result of the pipeline’s operation.

10.2.7 Proposed mitigation and management measures – Noise and Vibration

Potential Impacts	Mitigation measures
Construction	
Rock blasting annoyance	- Controlled blasting techniques would be employed at all times. - Rock blasting would only be undertaken during the hours of 9am–5pm. - Blasting mats would be used wherever possible to minimise dust

Potential Impacts	Mitigation measures
Construction	
	and stray debris.
Increased noise impact on nearby residences	- Adopt management practices consistent with Section 4.5.1 of the APIA Code. - 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. - Actively consult with affected receivers (isolated residences within 350m of the construction activities) ahead of construction activities, and provide affected receivers 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. - Site inductions would include appropriate behaviour on site to minimise disruptive noise (example no shouting, slamming doors etc), particularly during night works. - Complaints relating to noise and vibration from construction activities will be promptly investigated and where reasonable and feasible, additional controls implemented.
Operations	
Noise impacts from operation of above ground structure	- All above ground structure detailed design will meet the requirement of the NSW Industrial Noise Policy 2000.
Noise impacts from maintenance activities	- Machinery will be regularly serviced and maintained to optimum working conditions to minimise potential noise and vibration impacts. - The complaints response fact sheet prepared for the construction phase potential receivers will be used if complaints are received as a result of maintenance activities. - Where practicable, maintenance activities will be undertaken during standard hours of work when possible.

10.3 Air Quality

10.3.1 Assessment Methodology

A qualitative assessment was undertaken to evaluate the potential for significant human amenity impacts associated with dust. Dust is generated by the processes of wind erosion on exposed soils. Construction activities often result in some dust generation due to the need to undertake clearing and grubbing, excavation or trenching, stockpiling of soils, vehicle movements on unsealed road and the movement of uncovered loads of soil and or waste. This assessment includes a review of potential sources of fugitive (uncontrolled) emissions as well as potential receptors during construction and operational phases of the Proposal. A number of mitigation measures were also identified to be implemented in order to minimise the potential impacts to air quality.

10.3.2 Existing Environment

Climatic Influences

Climatic factors (specifically day to day weather i.e. winds and temperature) impact the level of dust generation, dispersion and deposition. Wind speed and direction are the most important meteorological conditions relating to the dispersion of emissions and the potential for impacts on sensitive receptors.

Given the importance of these factors a review of the wind roses at Wagga Wagga and Young was conducted to gain an appreciation of wind conditions across the study area (see Figure 13). Morning winds are typically easterly (with wind speeds between 10 and 40 km/h) and westerly in the afternoon (with wind speeds between 10 and more than 40 km/h) at Wagga Wagga. At Young, morning winds are fairly variable – north, east, south-east and south – with wind speeds between 10 and 40 km/h; afternoon winds are typically westerly in the afternoon with wind speeds between 10 and 40 km/h.

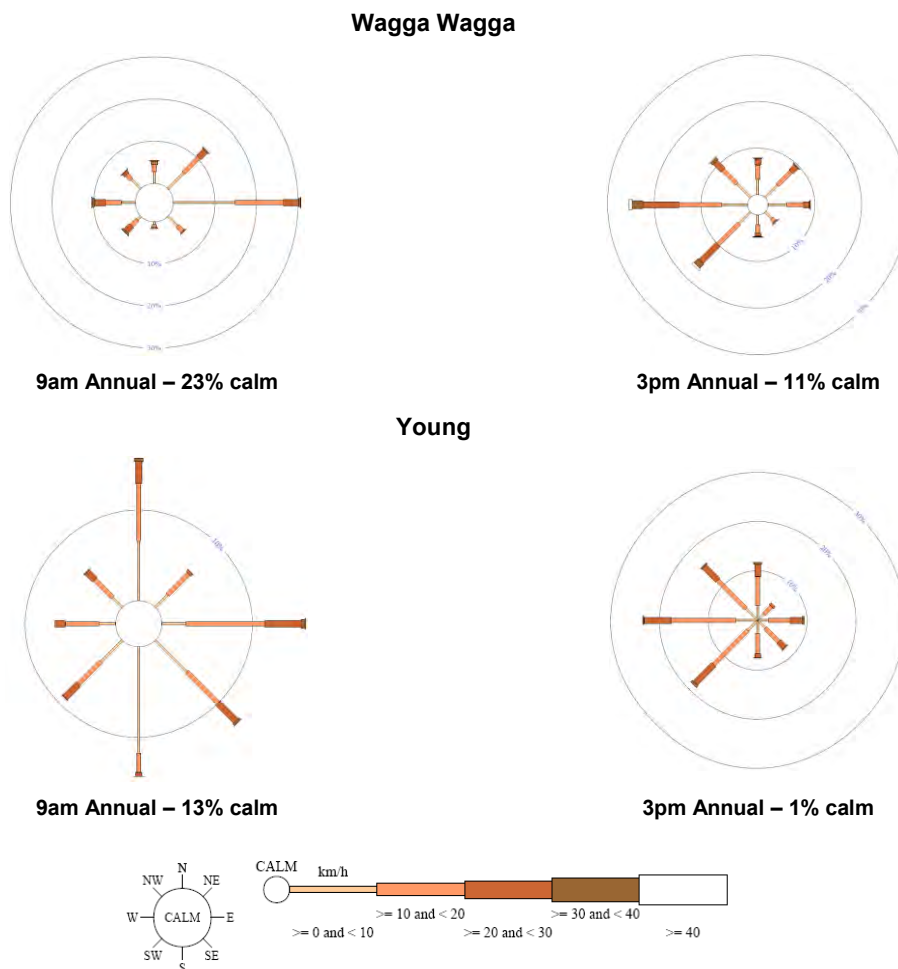


Figure 13 – Wagga Wagga and Young Wind Roses (BoM, 2011)

During the morning there is greater likelihood of calms, with the winds becoming stronger during the day. High winds tend to disperse the airborne material more effectively than low winds. Calms (or periods of low wind speed) are an efficient transporter of pollutants at higher concentrations because dilution in the surrounding air is reduced with less turbulent mixing.

Overall the wind speed recorded at Wagga Wagga and Young (no data available for June) are relatively low at 9 am and slightly higher at 3 pm, see Table 23.

Table 23 – Mean maximum and minimum wind speeds

Location	Mean maximum wind speed	Mean minimum wind speed
Wagga Wagga	13 km/h (December – 9 am) 17.7 km/h (December – 3 pm)	6.5 km/h (June – 9 am) 10.7 km/h (June – 3 pm)
Young	14.5 km/h (December – 9 am) 17.3 km/h (December – 3 pm)	7.4 km/h (July – 9 am) 13.4 km/h (May – 3 pm)

Source: <http://www.bom.gov.au> (06/10/2009)

Rainfall and precipitation will also affect the dispersion of air pollutants as it dampens the soil and reduces the potential for dust generation and wind erosion.

10.3.3 Human Receptors

As identified in Section 10.1, an analysis of GIS data was used to develop an indication of likely human receptors located within proximity to the Proposal. The potential receptors sensitive to air quality impacts adjacent to the Proposal are low density rural properties. There are higher densities of residential developments around towns such as Cootamundra and Wallendbeen, which are located further away from the Proposal site (~1-3 km) and accordingly are unlikely to be affected by any dust generated from construction activities. Importantly there are no more than 10 residences identified within approximately 250 m of the construction site.

The sensitivity of the rural residential receptors varies depending on the existing air quality and exposure to existing dust impacts. Many rural properties in this area currently experience dust from cropping and tillage activities and unsealed roads.

10.3.4 Potential Impacts

During Construction

Dust

The generation of dust during construction activities is the result of particulate matter being mobilised from an exposed surface (excavated ground or material stockpiles) and suspended in the atmosphere. The suspension of dust particles is determined by a range of parameters such as the shape and size of the particle, material composition, prevailing weather conditions, area of exposed ground, moisture content, and the type of activity being carried out. The primary source of dust during construction is from fugitive sources. Activities identified as potential fugitive dust sources include:

- Vegetation clearing, trenching, backfilling and reinstatement.
- Wind erosion from stockpiling of excavated materials – topsoil and trench spoil.
- Movement of vehicles and construction machinery, both within and accessing the construction site.
- Use of the padding machinery.
- Drilling and blasting at hard rock areas to establish the trench path.

Studies have indicated that the majority of fugitive dust emissions return to the surface within 60 to 90 m of the emission source. However, the fine fraction of dust particles, when mobilised, may travel up to 250 m from the source before returning to the surface. Due to the very low density of development in the vicinity, and as residences are generally greater than 250 m from works the potential for significant impacts are reduced.

A small number of residences (less than five) are located within 250 m of the Proposal, as indicated in Section 10.3.3, and as such may experience adverse impacts from dust during construction and rehabilitation activities.

Emissions

Vehicles generate emissions as a result of fuel combustion. During construction, the heavy vehicle traffic would not generate sufficient vehicle emissions to compromise air quality if they are operated and maintained in accordance with relevant regulations.

10.3.5 During Operation

It is unlikely that the Proposal will have any impact on air quality during its operation. This is due to the location of the Proposal underground and passive maintenance requirements. The construction path for the Proposal would be rehabilitated after completion of the works to minimise the potential for dust generation during operation. Ongoing emissions may be associated with maintenance activities (e.g. pipeline purging) and gas venting during emergency situations. This type of event is unlikely to significantly impact air quality due to its short term nature and isolated location.

10.3.6 Proposed mitigation and management measures

Given the short-term duration of the construction spreads, ambient air monitoring is not deemed necessary for the construction of the Proposal. However, daily visual checks would be undertaken to ensure that mitigation measures are effective and are being adhered to by construction staff and contractors. These mitigation and management 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 the course of the Proposal are outlined in Table 24.

Table 24 – Proposed mitigation and management measures

Potential Impacts	Mitigation and management measures
During Construction	
Reduction in air quality as a result of increased dust content 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, or similar measures, 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.
During Operation	
Release of air pollutants from fugitive gas emissions	- Regular maintenance checks, in accordance with AS 2885.3 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 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).

10.4 Traffic and Transport

10.4.1 Existing environment

The pipeline would involve a number of road crossings as discussed in Chapter 15.0. These roads vary from minor rural roads to major roads. For transportation of plant and equipment for construction a number of major highways in NSW and Victoria would likely be used as transport routes, such as the Olympic Highway and the Hume Freeway.

10.4.2 Potential Impacts

Construction

Potential impacts on the road network during the construction period would be associated with:

- Mobilisation and demobilisation of plant and equipment to the site ;
- Transportation of pipe sections from supplier to ROW or temporary stockpile location;
- Construction activity at or near a road; and
- 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 minimise the amount of padding to be brought in. The method of transport for all construction related activities is likely to be by road as this is likely to be the most practicable, efficient and cost effective means available. Rail networks may be utilised however this is not the current preferred option.

Table 25 outlines estimated vehicle movements for activities that may have a potential impact on existing traffic and transport levels.

Table 25 – Vehicle Movements

Activity	Vehicle Movements
Mobilisation and demobilisation of plant and equipment to the site.	50 movements (35 t trucks)
Transportation of pipe sections from supplier to ROW or temporary stockpile location	140 loaded truck movements (24 t trucks)
The transportation of activities between the ROW and accommodation facilities	50 light vehicles (mainly 4WDs) that will be used to transport up to 50 personnel daily. 10 trips per day for water cartage. Three trips per day for fuel deliveries. Two trips per day for floating equipment around the construction corridor.

The estimated numbers in Table 25 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 and equipment to the site

Pipeline construction typically involves initial delivery of construction plant and equipment and compound facilities and then daily movements associated with construction workers and pipe deliveries. Construction plant and equipment would then be demobilised from site at the completion of construction works.

Typical equipment used in pipeline construction includes: bulldozers, graders, trucks, excavators, loaders, side-boom tractors, padding machines, welding units and wheel ditching machines. Whilst the bulk of the earthmoving equipment (e.g. excavators, graders, water trucks) would generally be sourced locally, specialist plant and equipment (e.g. pipe bending machines, side booms and padding machines) may be required to be sourced from interstate.

Plant and equipment will likely arrive by road. Once delivered to the start of the proposed pipeline much of the plant, equipment and heavy vehicles required for construction would travel almost exclusively along the ROW from the start to the finish construction as far as possible. The likely exceptions to this would be:

- Line pipe haulage;
- Transport around major rivers or physical obstacles;
- Special crews, such as horizontal boring and hydrostatic pressure testing whose work is not contiguous;
- Daily servicing of work crews and equipment; and
- Water haulage for dust suppression.

Potential impacts from mobilising and demobilising equipment relates directly to traffic generation. The main impacts would be upon isolated receptors from traffic increases on local (minor) road networks and in areas with low existing traffic volumes. Impacts to major roads and highways as a result of traffic movements are considered negligible in comparison to the existing heavy vehicle traffic volume on these routes.

Transportation of pipe sections from supplier to ROW or temporary stockpile location

Pipe would typically be supplied in 18 m lengths transported on extended semi-trailers with a capacity to carry around 0.5 km of pipe per truck. Therefore 70 km of pipeline would involve approximately 140 loaded truck movements.

Pipes would be transported by road directly to the ROW ready for laying into the trench as far as possible. Pipe delivery timing, and resulting truck movement timing, is dependent on the progress and scheduling of the construction spread crews. Due to the linear nature of the development these truck movements would be spread across the 70 km pipeline route, and the resulting impact from these intermittent and distributed deliveries is minimal.

Pipes would be transported on a needs basis and would only be stockpiled for special crossings. If required a temporary stockpile of pipe sections may be located on land managed by the APA adjacent to the APA Control Room (KP 0.78).

Potential impacts from transportation of pipe sections relates directly to traffic generation as a result of movement of vehicles to the ROW. The main impacts on largely isolated receptors would be traffic increases on local (minor) road networks and in areas with low existing traffic volumes. Impacts to major roads and highways and the towns they intersect (containing sensitive receptors such as schools) as a result of traffic movements are considered negligible in comparison to the existing heavy vehicle traffic volume on these routes.

Construction activity at or near a road

The proposed pipeline transects and is parallel to a number of roads. These locations are discussed in Chapter 15.0

The typical crossing details for the various road types include:

- **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 (e.g. trenching, and the transport of plant and equipment across the road) and reduced speed limits.

At major roads potential impacts are expected to include speed limitations, as these crossings will be bored. Trenching through road crossings may potentially result in impacts on isolated receptors due to delays from temporary road closures or the use of a single lane with direction control being implemented.

Movement of the workforce between the ROW and accommodation facilities

A workforce of around 50 personnel at the peak period would be anticipated for the Project. Pipeline construction activities require a variety of skills sets from general earthworks through to specialised welding techniques. There are a limited number of companies that can provide the specialised techniques and therefore pipeline construction crews travel around the country from project to project and source generalised skills locally where appropriate. Accommodation of construction crews varies depending upon the size and location of the project. It is anticipated, due to the proximity to populated areas, that the construction crew for this Project would be able to be accommodated in existing local accommodation.

Activities that would require vehicle movements between the route and accommodation facilities include:

- Workers moving between the accommodation and the construction corridor;
- Water cartage for dust management;
- Transport for waste disposal;
- Fuel deliveries; and
- Floating equipment around major obstacles to the continuing construction corridor.

Haulage of fuel for use at site would be by conventional road tankers through a licensed provider. Refueling of project plant and equipment would likely 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 (i.e. 28 days on / 9 days off) where crews are unable to utilize personal vehicles 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 accommodation to the ROW would include an increased number of vehicles on the local road networks, although peak movement are expected to be outside of any "peak" times.

Operation

Potential impacts posed during operation of the proposed pipeline as a result of traffic generation will be very minimal. The majority of the impact will be by light vehicles (mainly 4WDs) used for routine inspection and ongoing light maintenance purposes. On occasion the proposed pipeline may require more extensive maintenance activities, however it is likely that the traffic impacts as a result of these would be local and only impact adjacent landowners.

10.4.3 Proposed Mitigation and Management Measures

General traffic and transport impacts construction as a result of the proposal during would be manageable through the implementation of standard mitigation and management measures as outlined in Table 26.

Table 26 – Traffic and Transport Management and Mitigation Measures during Construction

Potential Impacts	Mitigation and Management Measures
Construction Phase	
Mobilisation and demobilisation of plant and equipment to the site.	- 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 NSW RTA requirements.
Transportation of pipe sections from supplier to ROW or temporary stockpile location	- 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 NSW RTA requirements. - Where oversized vehicles are used, suitable controls and management will be put in place and heavy vehicle permits would be obtained as required.

Potential Impacts	Mitigation and Management Measures
	- Convoys of heavy vehicles would be avoided as far as practicable to minimise any impacts. - 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 Classified Road 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. - Where a road closure is required all signage would be installed in accordance with AS 1742.3 and the RTA Technical Direction TD 2006/05.
Movement of the workforce between the ROW and 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 movement of the workforce will be timed to avoid school zones to minimise impacts relating to increased traffic activity.
Operation Phase	
Larger Maintenance Activities	- Further consultation with residents and road authorities (ie Councils and the RTA) to outline maintenance activity timeframes and to identify localised impacts on traffic networks. - Where appropriate utilise mitigation measures, detailed above in the construction phase, for transportation of pipe sections and construction activity at or near a road

11.0 Socio-economic Impacts

11.1 Socio-economic overview and demographics of the study area

The socio-economic assessment of the Study Area is divided into four LGAs through which the gas pipeline loop passes – Cootamundra, Harden, Junee and Young. Data in this section is drawn from the Australian Bureau of Statistics (ABS) website as well as the local council websites. It is important to note that the next census in Australia is due to take place this year in 2011.

11.1.1 Cootamundra Shire

Situated in the Riverina area, the Cootamundra Shire consists of the Cootamundra town itself and the two small villages, Stockinbingal and Wallendbeen. In 2008 the town and two villages had a combined population of 7530. Over the three years from 2006 to 2008 ABS statistics demonstrate that this population has been slowly declining but this has been by no more than 30 to 80 people per year and previous to this was slowly increasing. At the last census in 2006, 3.6% of the Cootamundra population was Indigenous. As a smaller geographic area the population is somewhat dense for the Riverina with 4.9 persons/km². The majority of the population are also in family households (70% in 2006) rather than lone persons or group houses. In Cootamundra there are four public schools with a high school in Cootamundra as well as a Sacred Heart Central School in Cootamundra. The shire also hosts one higher education institution, the Cootamundra College of TAFE and at the last census in 2006 43.6% of the Cootamundra shire population over the age of 15 had some type of post school qualification.

Industry and Employment

Agriculture is the largest industry in Cootamundra with the major agribusinesses including cattle, grains, fat lambs and wool on a large scale. There has also been the expansion of 'boutique' farming which sees agriculture products prepared for both the local and export markets. The main industries employing the Cootamundra workforce are rural, retail, health and social care, manufacturing and transport and storages which in 2006 together employed 53%. Positioned on the main rail route between Melbourne and Sydney and only two hours from Canberra by road, Cootamundra shire is a transportation hub for bus, rail and truck services. As aforementioned there has been a number of value added agricultural industries emerging recently which offer new types of work. Some of these include fellmongering, tanning, abattoir and the making of speciality products such as jerky, wool skin and gourmet oils. Other developing industries that have been increasing their employment opportunities include primary produce processing, small farm enterprises, waste management, recycling and agricultural research. Even with the rise of new businesses and employment places unemployment in Cootamundra was around the national average of 4.3% in 2008. The average annual taxable income in 2007 was \$ 32 818 and the average wage and salary income in the shire was \$ 34 611.

11.1.2 Harden Shire

Covering an area of 1861 km² the Harden Shire is located adjacent to the Riverina region in NSW and Capital Country in the ACT and includes the main township of Harden Murrumburrah as well as the four villages Jugiong, Kingsvale, Galong and Wombat. In 2008 the population was 3636 having declined by around 200 in the last decade which has been a similar trend in other shires in the region. At the last census 2.7% of the Harden Shire population identified as Indigenous (higher than the national average of 2.2%) and around 5% of the population was born overseas. The majority of people in Harden Shire live in family households and as a rural shire with few townships the population density is in the middle range with 2 persons per square kilometre. In regards to education, Harden Shire hosts a few public schools and one Catholic school for locals to attend.

Industry and Employment

Situated in one of the largest wheat and grain producing areas in the country Harden Shire has a diverse range of both general and agricultural support industries including wheat, canola, oats, lupin, stone fruit, wool, wine, mustard oil, lamb, beef and livestock and wool storage and brokerage. As an important railway town in south west New South Wales Harden Shire is also the base of a large transport sector catering for light and heavy freight plus stock and refrigerated transport. Contributions to local agribusiness employment in Harden also include an abattoir, dairy, large grain-storage silos, sheep farms, cattle and horse studs, pig, deer and ostrich farms and vineyards. The main non-agricultural employers are transport, retail and health care and social assistance (around 54.5% with agriculture). The median individual income for the Harden Shire in 2006 was \$ 357 per week and the median household income was \$ 659 (compared to \$ 1034 for the state).

11.1.3 Junee Shire

The Junee Shire Council area covers approximately 2000 km² and in 2007 had a population of 6073. The population density is fairly similar to other shires in the area with 3 persons per square kilometre who live within and around Junee, Bethungra, Illabo and Old Junee. At the last census in 2006 Junee had a much higher than national average Indigenous population at 5.6% of the total population and 6.9% of the population had been born overseas. Junee has a number of schools across the shire, however being quite a small shire there are no higher education facilities. Regardless of this Junee has a much higher percentage of its population over 15 with a post school qualification, 53.2% compared to the Riverina average of 35%. The largest of these groups includes people with a Certificate Level qualification according to the 2006 Census although 26.4% of the 53 did not describe or state what level of qualification had been attained.

Industry and Employment

Agriculture is the major industry in Junee and it is an area well known for its lamb and crops of wheat, canola, oats, barley and triticale. There is also quite a large manufacturing-agricultural sector especially for meat processing and organic flour. Secondary industries of Junee are similar to other LGA's with construction, retail trade and property and business services having large numbers of businesses in the Shire. Junee also has a strong transport industry with not just commercial but freight rail services passing through from June to Sydney and also down to Melbourne, Australia's two largest capital cities. Two of the largest employers in the Junee Shire are the agriculture and transport and storage industries. While there is a wide variety of employment available in 2008 the level of unemployment, 5.2% was slightly above the average in Australia of 4.2% at that time. In 2007 the average taxable income was \$ 32 827 per annum and the average wage and salary income was \$ 36 474.

11.1.4 Young Shire

Covering a land area of 2690 km² from the Riverina to the Central West Slopes and Plains, the Young Shire consists of the town of Young as well as the villages of Bendick Murrell, Bribbaree, Koorawatha, Monteagle and Murringo. Compared to most other regional areas in Australia, the population in Young Shire between the last two census witnessed an increase from 11 923 (in 2001) to 12 488 (in 2006). It is expected that this upward trend has continued at a rate of around 1% growth per year. The Indigenous population in 2006 was 2.6% (slightly higher than the national average) and 5.9% of Young Shire's population was born overseas. Young Shire has a wide variety of education facilities from child care and pre-school to primary and secondary options as well as schools for children with special needs. There are also two tertiary institutions the TAFE – Young Campus and the Central West Community College. 43.4% of Young Shire's population in 2006 had a post school qualification.

Industry and Employment

Young's major industries include agriculture, horticulture, construction, engineering and steel fabrication, retail and service industries. The area has in many ways become synonymous with its cherry (and other stone fruits), lamb and wine industries which have all thrived on Young's rich soils and good rainfall. Other strong business areas are cattle, pig and poultry production, mining, and tourism. The main employers in Young are the agriculture, retail, manufacturing, health care and social assistance and construction industries. At the last census the unemployment rate in the Shire was 4.8% with approximately 275 unemployed persons. In 2006 the average taxable income per annum was \$35 696 and the average wage and salary income was \$31 309. The data regarding the Local Government Areas from Section 11.2 is summarised in Table 27 below.

Table 27 – Demographics of LGA's through which the pipeline will pass (ABS, 2006)

Area	Estimated residential population	Area (km ²)	Population density (people/km ²)	Aboriginal & Torres Strait Islander population (%)	Average annual taxable income (\$/year)	Unemployment Rate (%)
Cootamundra	7597	1523	4.9	3.6	38 808	7.7
Harden	3725	1869	2.0	2.7	36 916	3.2
Junee	6050	2031	3.0	5.6	38 485	8.8
Young	12 488	2694	4.6	2.6	35 696	4.8
NSW	6 549 177			2.1	49 728	5.9
Australia	19 855 288			2.3	46 769	5.2

11.2 Potential Socio-economic Impacts

Potential social and economic impacts for this project are expected during the construction and operation phases with the greatest level of impact expected to occur during construction. The potential impacts during the construction phase are considered to be fairly minimal and it is expected that there would be a number of positive (although minor) impacts, especially for retail and services in town and village centres located near the pipeline. There would be negligible socio-economic impacts during operation.

11.2.1 Construction Phase

Social amenity and private land

Where the pipeline passes through the individual properties, landowners may be impacted by construction activities through a temporary loss of access to parts of the property and a potential loss of privacy. It may also involve the need for temporary storage or plant and equipment on site. With construction work carried out rapidly, however, the duration of this potential impact to individual landowners is expected to be short lived and it is expected that no residents will be required to relocate during this project. There are some risks with use of private land, especially holding cattle and sheep stock areas or properties in the equine industry. The majority of works will take place within the existing pipeline easement. Where the working width must extend beyond the current easement, each landholder will be consulted to identify and discuss site specific issues and requirements and where disturbances to land use occurs, land will be reinstated.

Employment

The construction phase is likely to create a minor short-term positive impact on local employment and at the peak of the project it is expected that there will be a workforce of approximately 50 personnel. Most of the roles in the construction stage are for the pipeline specialists who need specialist skills such as high-pressure pipeline welding brought in by companies from outside the area. There are some opportunities for more generalist local and Indigenous labour to work on aspects of the pipeline such as clearing and grading of the land. Local communities in the area of this project are generally employed in a range of industries, such as manufacturing and construction with skilled tradespeople in high demand and may be available for some of the more general work.

Local economic activity

Due to the proximity of the works to Cootamundra and Young as well as Junee and Harden it is anticipated that the Proposal has the potential to generate some positive local economic activity during the construction period. Some of this activity will include the use of local rental accommodation for the out-of-town construction crew, procurement of various goods and services such as food, fuel and other supplies to support the workers, as well as the potential use of local facilities and infrastructure. Access to local facilities for equipment and pipe delivery and then material storage may be required during the construction phase as well as access to rail lines for transport of pipes and other materials. It is expected that overall all these activities will contribute positively to local economic activity and be consequently seen as beneficial to the local surrounding communities.

11.2.2 Operation phase

Privacy and access

One of the main concerns with pipelines on private land is the interruption from maintenance and inspection of the pipelines. For the most part inspections would be carried out remotely or aurally by small planes or helicopters (minimal noise) and would not require access to the private properties. Where access is required, for closer inspection or maintenance there might be some negligible impacts (no expected changes compared to current maintenance regimes).

Employment

It is anticipated that the increase in operational activities of having to have two pipelines managed instead of one will be negligible – equating to less than one man per year. Maintenance and inspections will most likely be carried out by existing staff at the Young base or by a possible additional employee. The pipeline would, therefore, have no effect on unemployment rates or wages in the LGA's.

Future land use

After the construction of the pipeline, once the trench has been filled and the pipe buried, the easement condition would be returned to pre-construction conditions and the productivity of existing land use activities would resume. Therefore future land use is not expected to be any different from the current land-use as a result of the Proposal.

Local and regional economic development and social potential impact

Some of the local and regional economic developments associated with the Proposal are likely to include:

- Increasing the existing pipeline's capacity to supply gas to the domestic, industrial and commercial users in the central south NSW towns including Harden, Junee, Young and Cootamundra;
- Increase the existing pipeline's capacity to transport Moomba gas from South Australia to Victoria and Bass Strait gas from Longford to Sydney; and
- It is unlikely that during operation, the looping pipelines will lead to demographic change or impact the need for social infrastructure and services in the area.

11.3 Proposed Mitigation Measures

As emphasised in Section 11.2 the socio-economic impacts of constructing and operating a looping pipeline between Bethungra and Young are anticipated to be either negligible or slightly positive. The construction phase could provide minor employment opportunities for local residents and increased use of goods, services and infrastructure. The operation phase is considered to have potentially negligible impacts. Table 28 below synthesises the impacts discussed in Section 11.2 and provides possible mitigation measures or strategies to enhance opportunities.

Table 28 – Potential impacts and proposed mitigation measures

Potential Impacts	Proposed mitigation measures
During Construction	
Reduction in privacy and private access	Landowners will be consulted to decide on the best access routes and areas for possible equipment storage. Work will be carried out quickly to reduce the length of time of the disruptions.
Disturbance to agricultural activities	To minimise disturbance to agricultural land use, landowners with stock or horses will be consulted to see if movement of stock away from areas is possible. Where movement is not possible or where access routes pass through stock areas workers will be warned in advance and instructed on the course of action for passing through or working in these areas.
During Operation	
Reduction in privacy and private access	On the rare or infrequent event that inspection or maintenance to the pipeline easement involves crossing private properties this will be carried out in consultation with local landowners.

Proposed mitigation and management measures relating to socio-economic operational impacts such as future land use and hazards and risks associated with the ongoing operations of the pipeline are addressed in other sections in this report.

12.0 Land Use Planning

This section addresses the potential land use impacts of the looping pipeline and proposes measures for managing and mitigating against any potential impacts. Because of the existing pipeline it is expected that potential impacts on land use will be negligible during operation and it is unlikely for the Proposal to generate any further land use conflicts. Moreover, to mitigate impact during construction the pipeline design and methodology for construction has been developed to ensure that all impacts will be minimised through consultation and other measures.

12.1 Assessment of land use impacts

12.1.1 Agricultural land uses

Over the four shires, Cootamundra, Young, Harden and Junee the land is predominately used for dry land agricultural industries of livestock, grazing and cropping. There are some more niche agricultural industries such as vineyards and fruits but these are in the minority. The NSW DPI classifies land into five classes according to its suitability for agricultural uses. These classification categories include:

- **Class 1** – Arable land suitable for intensive cultivation
- **Class 2** – Arable land suitable for regular, but not continuous cultivation
- **Class 3** – Grazing land or land well suited to pasture improvement
- **Class 4** – Land suitable for grazing, but not for cultivation
- **Class 5** – Land unsuitable for agriculture or at best suitable for occasional light grazing.

The study area in question mostly falls across land uses in Classes 1 and 3.

12.1.2 Conservation areas

NSW conservation areas are lands reserved to protect and conserve significant ecosystems, natural phenomena, landforms or places of cultural significance, while providing opportunities for sustainable visitation, enjoyment, use of buildings and research. In the proposed area of pipeline there are no conservation areas as registered on the NSW Conservation area website⁴.

There is one state forest, the Jindalee State Forest, which covers an area of around 1400 ha near the town of Cootamundra (as shown in Figure 1). The one note for this land use assessment is the large number of threatened flora that exists in the forest including the Painted Honey Eater, Squirrel Gilder and Brown Treecreeper. Jindalee State Forest is located over 1 km from the proposed pipeline; given the distance between the Proposal and the State Forest, there are no adverse impacts expected from either construction or operation of the pipeline.

12.1.3 Crown Land

Crown Land is land that is owned and managed by the NSW State Government and which can be categorised as either tenured (held by an individual or tenant) or reserved (set aside on behalf of the government for public enjoyment). Over half of NSW is identified as Crown Land and the existing pipeline easement traverses a number of landholdings owned and/or managed by the NSW LPMA (see also Figure 1). This will have some impact on the pipeline construction process as the LPMA need to be consulted prior to and during construction.

12.1.4 Extractive industries and resources

To ascertain whether there are any mineral and extractive resource industries in the Study Area a review was undertaken of the DPI Minerals and Major Deposits Mapping⁵. The map of NSW suggested that there are no mineral or extractive resources in the area and it is unlikely that there will be any impacts on mineral or extractive works as a result of the pipeline works. There is one mine, the Nickel-Cobalt Mine, in the north west of the Young Shire, however this is in a different direction to that the pipe will travel and should not be affected by the construction or operation of the pipeline.

⁴ <http://www.environment.nsw.gov.au/nationalparks/parktypes.aspx?type=stateconservationarea>

⁵ Refer to: <http://www.dpi.nsw.gov.au/aboutus/resources/maps>

12.2 Local Government Area Description

12.2.1 Young Shire

Covering a land area from the Riverina to the Central West Slopes and Plains, the Young Shire has a large number of agricultural industries that spread across its land space which include cherries (and other stone fruits), lamb, wine, cattle, put and poultry. Other key industries include engineering and steel fabrication, retail and services as well as mining and tourism.

12.2.2 Harden Shire

The Harden Shire is located adjacent to the Riverina Region in NSW and Capital Country in the ACT and is situated in one of the largest wheat and grain producing areas in the country. In regards to land use Harden Shire has a diverse range of both general and agricultural support industries including wheat, canola, oats, lupin, stone fruit, wool, wine, mustard oil, lamb, beef and livestock and wool storage and brokerage. As an important railway town in south west New South Wales Harden Shire is also the base of a large transport sector catering for light and heavy freight plus stock and refrigerated transport.

12.2.3 Cootamundra Shire

Cootamundra is situated in the Riverina area and is a rich agricultural centre in NSW with major agribusinesses including cattle, grains, fat lambs and wool on a large scale. There has also been the expansion of 'boutique' farming which sees agriculture products prepared for both the local and export markets. Positioned on the main rail route between Melbourne and Sydney and only two hours from Canberra by road, Cootamundra shire is a transportation hub for bus, rail and truck services.

12.2.4 Junee Shire

Situated in the Riverina Area, the Junee Shire is an agriculturally dominated Local Government Area. Junee is well known for its lamb and crops of wheat, canola, oats, barley and triticale and also has a large manufacturing-agricultural sector especially for meat processing and organic flour. As well as agriculture Junee has a strong transport industry with not just commercial but freight rail services passing through from Junee to Sydney and also down to Melbourne, Australia's two largest capital cities.

12.3 Potential Impacts on Land Use

It is anticipated that as the pipeline is being constructed within an existing easement there will be no requirement for acquisition of additional land. There will be, however, a temporary construction width of approximately 10 m which will be required for the length of the pipeline to enable construction activities to be undertaken.

Some potential impacts are anticipated during pipeline construction and should be only minor and short term. These potential impacts might have consequences on agricultural activities and ultimately crop yield for a maximum of one season. However prior to construction these potential impacts would be identified and compensation would be negotiated with individual landholders. Throughout the construction process landholders would be consulted extensively as a key part of managing potential impacts on specific areas of agricultural production. Negotiations of terms in relation to property access and conditions relating to construction activities on their land where appropriate, would be discussed with individual land owners.

Following completion of construction the area would be rehabilitated and in general terms normal practices could resume. For instance, the current easement is used for grazing and cropping and following construction the area would be rehabilitated to enable the continuation of existing agricultural activities. Table 29 provides a synthesis of potential land use impacts and proposed mitigation measures.

Table 29 – Potential impacts on land use and proposed mitigation measures

Identified impact	Impact classification	Proposed mitigation measures
Existing crown land or conservation areas		
Works carried out within proximity or on crown lands	Impact during construction	- NSW Land and Property Management Authority (LPMA) to be contacted to be notified about areas where the pipeline affects reserved crown land
	Negligible impact during operation (due to rehabilitation)	- LPMA to be reassured of the rehabilitation process that will ensure that everything in crown land will be returned to its previous status; reinstatement of creek

Identified impact	Impact classification	Proposed mitigation measures
		profiles and other drainage lines, existing vegetation profiles and the natural profile of the land.
Existing rural residential lots		
There is potential for rural residential lots to experience impacts associated with construction activities	Impact during construction Negligible impact during operation (due to rehabilitation).	- All affected landowners would be notified in advance of any potentially disruptive activities. - The outcomes of consultation with landholders would be taken into account in refinement of construction scheduling, temporary easement creation and in relation to construction activities on agricultural land.
General agricultural uses		
The study area traverses general and contiguous agricultural land and comprises land subject to agricultural activities with a classification of between Class 2 and 4. The proposed works may result in temporary loss of productive capacity of this agricultural land during construction. However, the works will not change the existing landform or sterilise any further land.	Impact during construction. Negligible impact during operation (due to rehabilitation).	- No additional permanent land acquisition is necessary due to the works being undertaken within the existing easement. Temporary land acquisition will be required for the construction phase. - All affected landowners would be notified in advance of any potentially disruptive activities. - The proposed works will be operated in association with existing pipeline infrastructure therefore impacts are considered to be minimal. - Land used as a part of the temporary construction easement will be rehabilitated post construction. - The proposed works are a consistent land use with the existing activity occurring on the land. - The buried depth of the pipeline will ensure that general cropping and grazing activities will be possible on parts of the easement.
A number of property dividing fences will require demolition to facilitate construction activities.	Impact during construction. Negligible impact during operation (due to rehabilitation).	- Temporary fencing and gates will be erected where required during construction and property dividing fencing reinstated post construction. - All affected landowners would be notified in advance of any potentially disruptive activities.
The pipe passes through a large equine farm (Darley) in the area which may cause some disruption especially if construction is carried out during breeding season.	Impact during construction. Negligible impact during operation.	- Darley landowners would be notified in advance of any potentially disruptive activities. - Construction scheduling where practical, according to property owners' requirements. .

13.0 Preliminary Hazard and Risk Assessment

In accordance with the Director-General's requirements, a preliminary hazard and risk assessment has been prepared consisting of two parts:

- A qualitative risk assessment based on AS 2885.
- A quantitative risk assessment (QRA), 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).

A Preliminary Hazard Analysis (PHA) for risks during the operational stage was carried out by Planager Risk Management Consulting (Appendix D), based on provisional design details, typical pipeline safeguards and conservative assumptions. The risk assessment would be updated and finalized once detailed design and operating procedures are available and a Final Hazard Analysis (FHA) report will be prepared and submitted for review and approval.

The following sections provide an assessment of the construction related risks.

13.1 AS 2885 qualitative risk assessment

The objective of the AS 2885 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. The AS 2885.1 qualitative risk assessment process is called the Safety Management Study (SMS) and is an integral part of pipeline design and construction. The outcomes of the SMS are to be reviewed once every five years during the operational phase to verify the applicability and currency of the SMS.

These reviews may lead to additional identified risks and /or additional mitigation measures necessary to continue to ensure the safe operation of the pipeline. The primary objective of SMS is that the pipeline is to be designed and constructed so that the residual risk from identified hazardous events is reduced to As Low As Reasonably Practical (ALARP). For identified events that cannot be controlled by physical or procedural measures, a failure analysis and qualitative evaluation of the hypothetical severity and likelihood is made taking into account the residual risk and typical pipeline safeguards, which would mitigate the impact of hazards. The residual risk has to be Intermediate or less provided that it has reached ALARP.

The AS 2885 risk assessment process leading to Safety Management Study shall be undertaken during detailed engineering and design phase. A preliminary summary of the hypothetical risk incidents during construction and operation is provided in the following section. The construction risks shall be formally identified and mitigated by the preparation, approval and implementation of Construction Safety Plan and Construction Environmental Management Plan.

13.1.1 Construction risk

Trench digging

Trench collapse during construction activity could result in injury or a fatality to construction personnel in the worst case. There is an increased potential for this type of incident to occur during wet conditions. The typical safeguards that would manage the risk of the incident include the following:

- Eliminate the requirement to access the trench as far as practicable. It is standard construction practice for tie-ins, large bell holes with battering and shorings to be placed in the trench.
- Development of a construction safety management procedure incorporating safeguards associated with this incident.
- Undertaking an excavation risk assessment as required under NSW 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, e.g. wet weather or other conditions as determined as a result of a risk assessment.

General construction 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 and so on.

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 would 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 and 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 forests (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 would include the following:

- Permit system prior to undertaking any 'hot works', e.g. welding and grinding.
- 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 'hot works'.
- 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 clearance distances are not maintained.

Typical safeguards to minimise this risk include the following:

- Use of markers on power lines so that they are easily visible to construction personnel.
- Use of high visibility tapes that clearly identifies safe working height under the power lines.
- Restriction on the type of equipment used in close proximity power lines.
- 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 guidelines for Safe Approach Distance to Electrical Apparatus.
- The potential hazard would be included in the Construction Safety Management Plan.

13.1.2 Operational risk

The pipeline is to be operated under an approved Safety and Operating Plan (SAOP). The project proponent is an experienced pipeline operator operating high pressure gas transmission pipelines all over Australia and particularly in NSW. The generic operational risks arising from the qualitative assessment are detailed in Table 30 below.

Table 30 – Qualitative assessment of operational risks

Event	Cause	Consequence	Typical Safeguards
Mechanical damage to the pipeline	3 rd party involvement, e.g. digging, trenching or other earthworks. 1 st party involvement from part wall damage or delayed failure.	Massive release of natural gas. If ignited, a possible flash or jet fire. Explosion causing projectiles such as earth, sand, stones. Fatality, injury and property damage.	- Signage along pipeline route including Dial-Before-You-Dig information. - Resistance of pipeline to penetration through the use of pipe thickness and adequate design to AS 2885. - Mainline valve (MLV) stations clearly marked and fenced.
Corrosion	Excavation for inspection damaging the pipeline coating. Construction damage, coating flaw or faulty materials.	Release of gas. If ignited, a possible jet fire. Fatality, injury and property damage.	- Cathodic protection for external corrosion. - Internal corrosion is virtually absent with clean hydrocarbons. - Routine inspections of pipelines. - Quality assurance during production and installation

Event	Cause	Consequence	Typical Safeguards
Nearby explosion	An incident at the parallel natural gas pipeline.	Damage to the proposed pipeline and release of natural gas. If ignited, a possible flash or jet fire. Fatality, injury and property damage.	- Internal risk management procedures / systems by gas pipeline operator. - 24 hour monitoring of pipelines. - Thickness and grade of the pipelines. - The pipelines would be separated by at least 7 metres. Further the existing pipeline is buried at 750mm while the proposed pipeline would be buried at 900mm.
Pressure excursion	Operational error either upstream or downstream of facility leading to overpressure in the pipeline.	Overpressure in the pipeline may cause leaks or other failure, releasing natural gas. If ignited, a possible fire. Fatality, injury and property damage.	- Pipeline would be constructed and hydrotested to AS 2885 requirements. - Continuous observation of pressure of pipeline from Control Centre at Young. - High-pressure trip and automatic line break protection isolating flow of natural gas. - Mechanical overpressure protection and controls at compressor stations.
Spontaneous loss of integrity of pipe	Construction defect or repeated operational error.	Massive release of natural gas. If ignited, a possible flash or jet fire. Fatality, injury and property damage.	- X-raying of welds as required. - 100% ultrasonic testing of Electric Resistance Welded (ERW) pipe seam welds. - Cathodic protection. - Design for pipeline to limit crack propagation to about 2 pipe lengths. - Pipeline complying with AS 2885 and other specific standards. - Pipeline subject to regular monitoring.
Erosion	Flood water washing away soil cover and exposing pipeline. Possibility of damage to coating and subsequent corrosion.	If corrosion not corrected may lead to failure of pipeline.	- Regular and periodic patrols and inspections to detect erosion. - Repair of soil cover if erosion present as required.
Land subsidence	Mining or seismic activity.	Failure of pipeline leading to rupture or massive leak of natural gas. If ignited, a possible flash or jet fire. Fatality, injury and property damage.	- The site is not affected by mine subsidence. - Design of pipe to AS 2885 requirements.

Event	Cause	Consequence	Typical Safeguards
Aircraft, train or heavy vehicle crash	Aircraft, train or heavy vehicle collision with pipeline.	Potential damage to pipeline and release of natural gas. Possible fire or explosion.	- As the pipeline would be buried it is unlikely to be susceptible to direct collision. - MLV stations would be located away from potential road or train crash locations. - MLV stations would be surrounded by security fencing.
Terrorism or vandalism	Malicious damage to the pipeline.	Massive release of natural gas. If ignited, a possible flash or jet fire. Fatality, injury and property damage.	- As the pipeline would be buried this reduces the potential for malicious damage. - MLV stations would be surrounded by security fencing. - Building doors would be fitted with intruder alarms.
Neighbouring bush fire	Bush fires causing heat radiation at the pipeline.	Damage to the pipe from heat radiation resulting in release of natural gas. The possibility of increased fire risk.	- Control of vegetation within the pipeline easement. - As the pipeline would be buried it is unlikely to be affected by heat radiation. - All above ground valves would be fire safe.

13.2 Quantitative risk assessment

The methodology for undertaking the QRA is as described in the NSW Department of Planning guidelines, *HIPAP No. 6, Guidelines for Hazard Analysis* and *HIPAP No.4*. The level of assessment was determined by use of the advice document *Multi-level Risk 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, injury risk and propagation risk in a per million per year (pmpp).

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 natural gas to the environment and subsequent ignition. The main types of failure incident reported are:

- External interference.
- Construction defect or material failure.
- Corrosion.
- Error during 'hot tapping'.
- Ground movement.
- Flooding.
- Land subsidence or mining activity damage.
- Aircraft, train or truck crash.
- Terrorism, vandalism, unlawful entry to site or sabotage.

- Bush or grass fire.
- Other or unknown causes including valve or flange leak, maintenance failure, nearby explosion or operational error causing pressure excursion.

13.2.1 Pipeline safeguards

The proposed pipeline would be designed and operated in accordance with AS 2885.1-2007 meeting the requirements for the appropriate location class as per Clause 4.3.4 of AS 2885.1-2007. 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 pipeline route passes predominantly through regions classified as *R1 – Broadly Rural*. Some areas are, or are expected to be in the near future, classified as *R2 – Rural Residential*.

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 as shown in the following sections.

Protection against external damage

- The pipeline would be buried to AS 2885 requirements as a minimum.
- Marker signs including 'Dial-Before-You-Dig' information.
- The thickness of the pipeline would provide a certain resistance to penetration.

Construction defect or material failure

- The pipeline would be designed and constructed to AS 2885 requirements as a minimum.
- ERW pipe seam welds would be 100% examined ultrasonically and circumferential butt welds 100% radiographed.
- Pipeline would be hydrotested at 1.38 times the maximum allowable operating pressure.

Corrosion Protection

- The pipeline would be coated with fusion bond epoxy and be cathodically protected.
- A corrosion survey would be undertaken each year.

Flooding

- Pipeline route would be subject to routine inspections. If erosion is detected, maintenance and repair would be undertaken as required.

Bush or grass fire

- Bush fires are highly unlikely to affect underground pipelines.
- An asset protection zone would be established in consultation with rural fire services.
- A clearance zone would be provided at the off-take compound with vegetation control undertaken within the zone.

13.2.2 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 this incident was presented as risk transects, showing the accumulated individual risk levels at any lateral distance from the centreline of the pipe. Generally the pipeline would be constructed with a 6.8 mm wall thickness.

Where the pipeline goes under road or railway line, or where it passes through major centres it will be constructed with a thicker 9.7 mm wall thickness pipe. Transects were developed for both wall thickness pipe scenarios.

Individual risk

Risk transects showing the fatality risk, injury risk and propagation risk versus the distance from the centreline of the pipe were produced for 6.8 mm and 9.7 mm wall thicknesses. The transects are provided in the Preliminary Hazard Analysis prepared by Planager Risk Management Consulting (Appendix D).

The transects show that the risk criterion relevant to residential development for individual fatality risk (1 pmpy), injury risk (50 pmpy) or propagation risk (50 pmpy) is never reached for any scenario.

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 proposed pipeline and the low individual risk, it is considered that the proposed pipeline would not have a significant impact on the societal risk.

13.3 Further assessment

As a result of the AS 2885 qualitative and quantitative risk assessment, a number of typical safeguards have been suggested for the identified risk events in the preceding sections. Despite the risk criteria of *HIPAP No.4* being adhered to for all scenarios, these typical safeguards would be implemented in line with the 'as low as reasonably practical 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 QRA would be updated following the guidelines of *HIPAP No.4* when details of the design and the exact location of the pipeline are finalised.

13.4 Proposed Mitigation Measures

Table 31 provides a summary of the hazard and risk mitigation and management measures that would be implemented during the pre-construction, construction and operation stages of the proposed pipeline.

Table 31 – Summary of hazard and proposed mitigation measures

Potential Impacts	Proposed mitigation measures
Pre-Construction	
Appropriate design standards not met	- Design of pipeline to meet the requirements of AS 2885 as a minimum. - Pipeline would be designed with a separation distance of at least 7 m from the existing pipeline. - Pipeline would be designed to be buried at 900 mm - Pipeline would be designed generally with a 6.8 mm wall thickness, with a 9.7 mm wall thickness where it goes under roads and railway lines, or passes through major centres.
During Construction	
General construction safety	- Specification of safety requirements as part of construction contractor selection process. - Development and implementation of a safety management plan for construction activities. - Development and implementation of safe work method statements for relevant construction tasks.
Trench collapse	- Excavation risk assessments undertaken prior to any excavation works. - Shoring up of trenching particularly where required to undertake welds at tie-in points.

Potential Impacts	Proposed mitigation measures
Construction along roads – traffic interface	- Development and implementation of a traffic management plan. - Liaison with local councils and/or the RTA to review the traffic management plan and proposed construction activities.
Construction in forests - bushfires	- Implementation of a permit system to undertake 'hot works'. - Restriction and control of all ignition sources. - Minimisation of combustion material in the vicinity of any 'hot works'. - Provision of fire fighting capabilities, both physical equipment and competent operators.
Construction near powerlines	- Restriction on the type of equipment used in proximity to powerlines. - Use of spotters when working with lifting equipment under power lines. - Training and certification of equipment operators.
Poor quality control leading to pipeline failure during operation	- Quality assurance procedures and system during production and installation. - Pipeline to be constructed to the requirements of AS 2885 as a minimum. - A 100% ultrasonic testing of pipe seam welds. - Circumferential butt welds would be 100% radiographed. - Pipeline would be hydrotested at a minimum of 1.25 times the maximum allowable operating pressure.
During Operation	
Mechanical damage to pipeline	- Signage along pipeline route including 'Dial-Before-You-Dig' information. - Mainline valve stations would be clearly marked and fenced. - The thickness of the pipeline would provide a certain resistance to penetration.
Corrosion	- Pipeline would be coated with a fusion bond epoxy and be cathodically protected. - Internal corrosion is virtually absent with clean hydrocarbons. - Routine inspections (at least yearly) of the pipeline.
Nearby explosion at parallel pipeline	- Internal risk management procedures / systems by gas pipelines operator. - Separation distance of at least 7 metres between pipelines. - A 24 hour monitoring of pipelines.
Pressure excursion	- Continuous observation of pressure of pipeline from Control Centre at Young. - High-pressure trip and automatic line break protection isolating flow of natural gas. - Mechanical overpressure protection and controls at compressor stations.
Spontaneous loss of integrity of pipe	- Quality control during the construction phase. - Regular monitoring of pipeline.
Erosion	- Regular and periodic patrols and inspections to detect any erosion. - Repair of soil cover as required if erosion is present.
Land subsidence	- The site is not affected by mine subsidence. - Design of pipe to AS 2885 requirements.
Aircraft, train or heavy vehicle crash	- As the pipeline would be buried it is unlikely to be susceptible to direct collision. - MLV stations would be located away from potential road and train crash locations. - MLV stations would be surrounded by security fencing.
Terrorism or vandalism	- As the pipeline would be buried this reduces the potential for malicious damage. - MLV stations would be surrounded by security fencing. - Building doors would be fitted with intruder alarms.
Neighbouring bushfire	- Control of vegetation with the pipeline easement. - As the pipeline would be buried, it would be unlikely to be affected by heat

Potential Impacts	Proposed mitigation measures
	radiation. - All above ground valves would be fire safe. - An asset protection zone would be established in consultation with the rural fire service. - A clearance zone would be provided at the off-take compound with vegetation control undertaken within this zone.

14.0 Surface and Groundwater

14.1 Assessment approach

14.1.1 Data sources

Surface watercourses and groundwater bores were identified sourcing data from:

- OEH
- NSW Office of Water (NOW)
- Geosciences Australia

The sensitivity of the watercourses has been determined based on data from:

- Aerial photography / GIS analysis / topographical maps.
- Classification and Characteristics of Waterway Type (Fairfull and Witheridge, 2003).
- RAMSAR listings.
- Water bore licences.

This part of the EA is based on desktop information only. Notwithstanding the assessment provides a robust consideration of the sensitivity of water features to the Proposal. However, characteristics of water courses are highly variable due to weather conditions. Therefore the focus of this assessment was to identify a framework for the management of potential impacts during construction and operation.

14.1.2 Methodology

Surface Water

Watercourse identification

Based on the data sources listed in Section 14.1.1, all watercourses that would be traversed by the proposed pipeline were identified. To maintain a consistent assessment across the entire study area, only data that represented surface water hydrology was used to identify watercourse features such as lakes, reservoirs, dams, rivers and creeks. Table 33 provides a summary of the assessment in tabular format, for each watercourse that would be intercepted by the proposal. For the purpose of this investigation, waterways that can be identified using aerial photography have been identified as 'watercourses' and other minor gullies identified with GIS flow paths have been identified as 'flow paths'.

Watercourse sensitivity

Each watercourse within the study area intercepted by the proposed pipeline was categorised according to its sensitivity based on the criteria in Table 32.

Table 32 – Sensitivity criteria for water quality and hydrology

High Sensitivity	Moderate Sensitivity	Low Sensitivity
- Good intact native riparian vegetation¹. - Highly sensitive downstream water users¹. - First or second class stream according to the Department of Primary Industries' Fish Habitat Classes². - RAMSAR listed wetlands downstream³.	- Moderate riparian vegetation, with some native species present. - Less sensitive downstream water users (e.g. may tolerate temporary increase in sediment load). - Third class stream according to the DPI' Fish Habitat Classes. - Shallow water tables (less than 1.5 m deep)⁴.	- Ephemeral stream. - No threatened species habitat. - Poor riparian vegetation – highly disturbed. - Fourth class stream according to the DPI' Fish Habitat Classes.

1. Aerial photography / GIS analysis / topographical maps / 2. Classification and Characteristics of Waterways Type (Fairfull and Witheridge, 2003)

/ 3. RAMSAR listings / 4. Groundwater bore licences

The sensitivity criteria listed in Table 32 uses the DPI's Fish Habitat Classes to assess the potential impacts on aquatic fauna. Specific assessment of the presence of, and potential impacts on threatened species is presented in Section 8.0 of the EA. The Fish Habitat Classes applies a basic 'Class' system to assign aquatic habitat values to waterways. The Fish Habitat Classes work in the reverse order to the Strahler system for determining the stream order, with a first class fish habitat being the most sensitive. The Fish Habitat Classes uses flow frequency, presence of threatened fish species habitats, presence of pools and wetlands, and the presence of aquatic vegetation to assign classes.

Watercourse crossing review

Each watercourse was then reviewed in relation to the potential construction techniques. Common pipeline construction methods proposed for the crossing of watercourses could include:

- Open cut with or without flow diversion (depending upon the flow of water in the watercourse and downstream sensitivities); and
- HDD.

The application of the various techniques for watercourse crossing is dependent on a number of factors, 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 OEH, DPI and NOW with regard to crossing methods and site specific management measures for high sensitivity watercourse crossings.

Surface and groundwater tiered assessment

Table 33 provides a summary of the surface and groundwater tiered assessment in tabular format, for each watercourse that would be intercepted by the proposal.

Table 33 – Water feature impact assessment

Water feature	KP	ID	Relevant sensitivity criteria	Sensitivity	Probable crossing method	Residual impact
McHenrys Creek	6.1	SW1	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Burrangong Creek	7.7	SW2	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	10.8	SW3	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Stony Creek	12.0	SW4	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.

Water feature	KP	ID	Relevant sensitivity criteria	Sensitivity	Probable crossing method	Residual impact
Unknown	14.3	SW5	- Ephemeral Creek - Poor to moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	22.3	SW6	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	23.0	SW7	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	24.0	SW8	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Tumbleton Creek	25.0	SW9	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Cunningham Creek	30.4	SW10	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Cunningham Creek	33.1	SW11	- Ephemeral Creek - Poor to moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	34.6	SW12	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.

Water feature	KP	ID	Relevant sensitivity criteria	Sensitivity	Probable crossing method	Residual impact
Unknown	35.9	SW13	- Ephemeral Creek - Poor to moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	36.3	SW14	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	39.1	SW15	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Jindalee Creek	41.3	SW16	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	45.3	SW17	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Muttama Creek	52.8	SW18	- Ephemeral Creek - Poor to moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	56.5	SW19	- Ephemeral Creek - Poor riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes	Low	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Cootamundra Creek	57.6	SW20	- Ephemeral Creek - Poor to moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.

Water feature	KP	ID	Relevant sensitivity criteria	Sensitivity	Probable crossing method	Residual impact
Salt Clay Creek	57.8	SW21	- Ephemeral Creek - Poor to moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Cunjegong Creek	66.0	SW22	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	68.3	SW23	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	68.7	SW24	- Ephemeral Creek - Moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes - Less sensitive downstream agricultural water users	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.
Unknown	70.0	SW25	- Ephemeral Creek - Poor to moderate riparian vegetation - 4th class stream according to the DPI Fish Habitat Classes	Moderate	Open trench with flow diversion (if flow diversion is necessary)	Minor – standard mitigation measures apply.

Groundwater

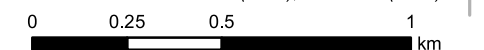
All known groundwater bores were plotted in relation to the study area (refer to Figure 14). Based on the data sources listed in Section 14.1.1 the groundwater bore levels were determined and compared to the likely depth of construction of the pipeline (i.e. 1.5 m typically below ground level based on 900 mm cover and a 450 mm pipe diameter). The potential impacts on groundwater were then assessed (refer to Section 14.3).



- | | | | |
|----------------------------------|---------------------------|----------------|----------|
| ★ Groundwater Bore (Depth ≤ 10m) | ○ Kilometre Points | LGA | Drainage |
| ★ Groundwater Bore (Depth > 10m) | — Gas Pipeline Section 2 | Highway | |
| ● Flowpath Crossing | — Other APA Gas Pipelines | Main Road | |
| ⊕ Watercourse Crossing | — ILLSEA_Drainage Line | Connector Road | |
| 📍 Localities | — Waterways | Local Road | |

**YOUNG - WAGGA WAGGA PIPELINE SECTION 2
Habitat and Threatened Ecological Communities Map**

Source: LPMA (2010), StreetPro (2009)



GDA94 - MGA Zone 55

19 Sep 2011
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Fig. **14A**



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|----------------------------------|---------------------------|------------------|------------|
| ★ Groundwater Bore (Depth ≤ 10m) | ○ Kilometre Points | □ LGA | ■ Drainage |
| ★ Groundwater Bore (Depth > 10m) | — Gas Pipeline Section 2 | — Highway | |
| ● Flowpath Crossing | — Other APA Gas Pipelines | — Main Road | |
| ⊕ Watercourse Crossing | — ILLSEA_Drainage Line | — Connector Road | |
| 🏠 Localities | — Waterways | — Local Road | |

**YOUNG - WAGGA WAGGA PIPELINE SECTION 2
Habitat and Threatened Ecological Communities Map**

Source: LPMA (2010), StreetPro (2009)

0 0.25 0.5 1 km
GDA94 - MGA Zone 55

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Fig. **14B**

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|----------------------------------|---------------------------|------------------|------------|
| ★ Groundwater Bore (Depth ≤ 10m) | ○ Kilometre Points | □ LGA | ■ Drainage |
| ★ Groundwater Bore (Depth > 10m) | — Gas Pipeline Section 2 | — Highway | |
| ● Flowpath Crossing | — Other APA Gas Pipelines | — Main Road | |
| ⊕ Watercourse Crossing | — ILLSEA_Drainage Line | — Connector Road | |
| 📍 Localities | — Waterways | — Local Road | |

**YOUNG - WAGGA WAGGA PIPELINE SECTION 2
Habitat and Threatened Ecological Communities Map**

Source: LPMA (2010), StreetPro (2009)

0 0.25 0.5 1 km
GDA94 - MGA Zone 55

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Fig. **14C**

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