Pipeline construction corridor, site compounds and stockpile areas

Site compounds, storage, stockpile and lay down areas would be required at various locations along the pipeline. The proposed locations of the facilities have generally been selected to occupy existing cleared areas or areas that would be cleared for the excavation of the pipeline trench.

Construction corridor

A 20 m wide (maximum) construction corridor would be required along the pipeline route to allow for trench excavation; equipment storage and movement of construction vehicles along the pipeline corridor; storage of topsoil, backfill and spoil; and bi-directional right of way access.

Clearing and grading would be minimised where practicable to the extent necessary for construction of the pipeline and would not exceed the 20 m construction corridor. The area that would be directly impacted upon by construction activities would range in width from 6 m to 20 m, depending on a range of factors considered that include occurrences of critical habitats for endangered species and communities, vegetation sensitivity and quality, constructability, construction management and safety considerations, land form, slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable with narrower construction corridors proposed where feasible. In areas that are timbered and where there are significant environmental concerns the clearing requirements for construction would be reduced a 6 m to 8 m wide construction corridor.

With some precautions on the part of the constructor, there is potentially some 8 to 9 m of the southern side of the existing gas pipeline 25 m wide easement that could be available for access and construction of the proposed water main. In many areas the PowerTel fibre optic underground cable provides a potential obstruction.

It is proposed that the water pipeline would be located generally on the south side of the gas pipeline easement in approximately a 6 m wide corridor. This may need to be offset depending on the location of the fibre optic.

Figure 6.8 shows the proposed construction corridor and the permanent pipeline easement relative to the existing gas pipeline easement and fibre optic cable.

In areas of steep terrain (that impact on construction methodology's available and construction safety) and problematic sub-soil conditions, the impact area would be wider than 10 m, but would always be less than 20 m. The Proponent has based the environmental assessment on an indicative corridor width that would be refined by the construction contractor.

Access to land for the purposes of construction, rehabilitation and operation of the pipeline is the subject of discussions and negotiations between the proponent and the landowners.

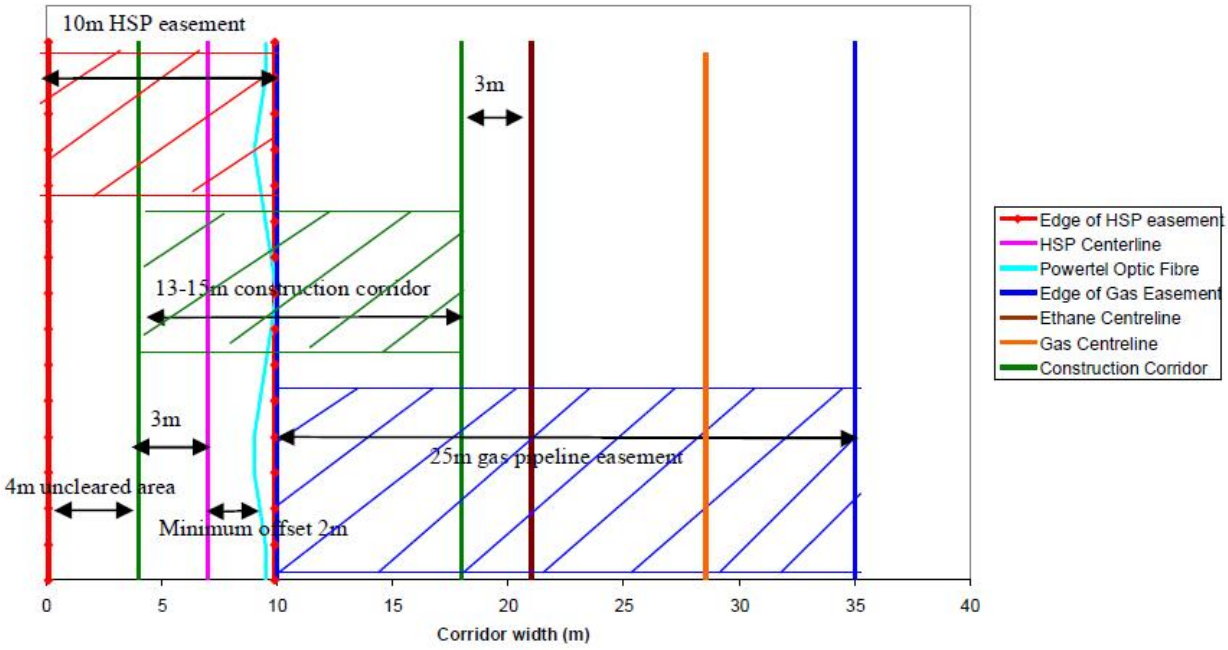


Figure 6.8 Pipeline Corridor Arrangements – Minimum Offset

Main construction office and site compounds

Primary and secondary site compounds would be required for the construction phase of the Project. Primary compounds would predominately be used for site offices, amenities, storage of major plant and equipment and storage of materials. Primary compounds would be located in close proximity to major construction sites and would provide adequate access and sighting for the Project.

Secondary site compounds would be predominately used for storage of minor plant, equipment and materials. Nominal amenities may also be provided in these locations. Secondary site compounds would also be located in areas close to major construction works. However, the area of secondary site compounds would generally be smaller than primary site compounds.

Each site would be securely fenced with temporary fencing. All necessary signage advising the general public of access restrictions relevant to each site would be provided. These areas would be reinstated at completion of use.

Location of the site offices would be determined and arranged by the nominated Construction Contractor. Marulan is a central location that is likely to be used, with other options including Goulburn, Moss Vale or Exeter. It is likely that some site offices would be established within or adjacent the Wingecarribee WTP area. Being essentially a linear project, plant and equipment will be progressively advancing along the pipeline route; hence it is unlikely that there will be large groups of equipment in one location at any point in time.

The site compounds would be located on previously leased disturbed land.

Stockpile and spoil areas

Stockpile and spoil areas would be located within the 20 m wide construction impact zone. Excavated material from the trench would be stockpiled adjacent to the trench and used to backfill the area of the trench above the laid pipeline. Generally for this size pipeline – approximately 40 km of 375 mm diameter pipeline and 40 km of 300 mm diameter pipeline – it is found that relative to the disturbed area required for construction that the volume of excess material is relatively small and is generally utilised for reinstating the pipeline corridor. In this case it would equate to an approximate spread depth of less than 50 mm of excess material across the construction impact zone (approximately 15 to 20 m wide by 83 km long). Additionally, most landholders have erosion areas where they are seeking to have any excess spoil placed.

Imported backfill material (*i.e.* sand) would be stockpiled in approximate 10 m by 10 m areas at approximate 200 m to 300 m intervals along the impacted zone. It is estimated that approximately 40 000 m^3 of imported backfill material would be required along the pipeline.

Temporary stockpile areas would be protected by sediment and erosion controls including temporary sediment fences. Stockpiles would be covered or controlled by wetting down where necessary to prevent impacts from dust.

Pipe lay down

Pipes would be delivered by semi-trailers to pipe lay down areas adjacent to existing roads and accesses at approximately 5 km to 10 km intervals nearby to the pipeline route. The pipes removed from the trucks and placed in the lay down areas using mobile cranes. Leases for lay down areas are usually negotiated with landholders and in some areas Council may have adequate areas within existing road reserves which could be used for this purpose.

Pipe lay down areas located within Council road reserves and private land would be fenced and public safety warning erected. Drainage controls would also be constructed where required.

Pipe lay down areas would also be located within the construction impact corridor, in many cases along the boundary of the existing 25 m wide gas pipeline easement. This easement is totally cleared and access may be available on one side of this corridor.

Signage

Water pipeline marker signs would also be installed along the pipeline route at 500 m intervals, horizontal bends, service crossings, either side of road crossings and at fence and gate crossings.

6.3 Pumping station

For both the raw water and treated water options, a new high lift pumping station would be located on the Wingecarribee water treatment plant site. Both schemes would be designed for a flow of 5 ML/d. However, as noted previously the scheme would be designed to accommodate a potential upgrade to supply of 7.5 ML/d. If this is required (in approximately 15 – 20 years) a booster pump station constructed in the vicinity of Marulan could be required. A schematic of the proposed pumping scheme is presented in Figure 6.9.

A high lift pumping station would be located adjacent to the existing raw water pumping station between the dam and the Wingecarribee WTP. This pumping station would initially be equipped to achieve a flow rate of 5 ML/d and would involve approximately 100 kW of pumping capacity.

The pumping station building is expected to be of a rectangular form to house most likely two duty pumps together with one standby pump. The building footprint would be of the order of 8 m by 15 m which would include the electrical and control equipment. The height of the pumping station would be approximately 5 m in order to provide for a monorail system.

The pumps required are relatively small. The initial preference would be to use single stage split casing pumps. Some consideration to using vertical spindle pumps may be given to overcome some potential flood level immunity requirements.

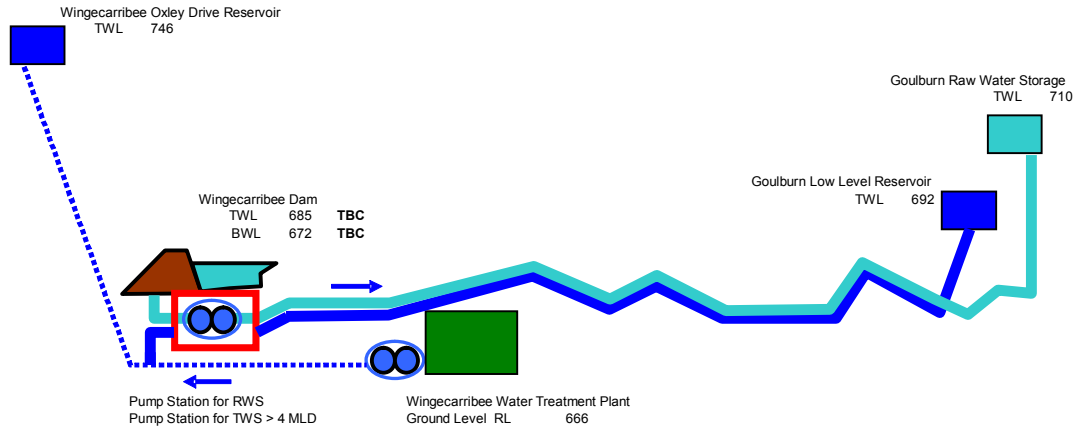


Figure 6.9 Schematic of the proposed water transfer scheme (not to scale)

6.4 Outlet point

6.4.1 Raw water transfer scheme

The pipeline would be constructed to an existing (but currently unused) water balance tank at the Goulburn WTP. Raw water would be discharged into this reservoir. From there, it would be treated at the water treatment plant and released into Goulburn's town water supply.

The Project includes constructing the connections of the pipeline to the outlet point into the reservoir.

6.4.2 Treated water transfer scheme

Two outlet points for the treated water transfer scheme are being considered.

One outlet point would discharge treated water into a proposed new reservoir on Governor's Hill, which is located to the east of Goulburn. The reservoir would be connected to the town water supply system on the eastern side of Goulburn. Planning approval to develop this reservoir is not being sought as part of the Project. An application seeking approval to develop the reservoir and connect it to the town's water supply system would be made in the future, if this is required.

The other outlet point being considered would be directly connecting the pipeline to the town's water supply system at a point in the water supply system east of Goulburn in the vicinity of Governor's Hill.

6.5 Crossings

6.5.1 Overview

The pipeline would cross major roads (the Hume and Illawarra Highways), local roads, railway lines (including the Moss Vale Unanderra Railway), various water bodies (including the Wollondilly River) and a number of services.

Based on a preliminary consideration of technical issues and environmental and geological constraints, a number of common construction methods are proposed to construct the crossings. The methods that would be adopted include:

- Trenching;
- Thrust boring; and
- Horizontal directional drilling (HDD) (sometimes termed 'under boring').

Bridge crossings can also be used to construct crossings. This would involve attaching a pipeline to a purposely built bridge structure or to an existing bridge. This method is also a common crossing construction method. At this stage, bridge crossings have not been identified at any point along the pipeline route, however requirements for pipe bridging may be identified during detailed design.

6.5.2 Agency requirements

Road crossings

The RTA has provided advice for undertaking roads crossings of Freeways, Highways, Motorways and Main Roads as follows:

- Work carried out by boring under the Roads and Highways shall be concrete encased;
- The pits for bores shall be located outside the road reserve wherever possible. Where this is not practical, then they would be no closer than three metres from the road pavement for both entry and exit holes. The depth would be not less than 1.2 m below road surface level to the top of the pipe or concrete.
- The RTA does not permit lane closures on the Hume Highway between the hours of 6:00am and 7:00pm, and as such, any activity requiring work on the road would be done at night.
- Where an underbore is required, there is normally a requirement for the bore head to be followed across the road. If this is the case then full traffic control would be required for this activity;
- Longitudinal trenching would be a minimum depth of 0.6 m when in the road reserve and as close as possible to the road boundary. The trench would not be within 3 m of the road edge line;
- All areas within the road reserve that are disturbed by work undertaken would be restored to their original condition upon completion of the work and all restoration work is to be carried out to the satisfaction of the RTA; and
- Markers would be placed at regular intervals to show the location of the conduit.

Railway crossings

ARTC manages the railways outside of the RailCorp Sydney Metropolitan region in NSW and as such has jurisdiction of the railways intersected by the proposed pipeline route. Construction of the pipeline within the railway boundary would be undertaken in accordance with:

- AS 4799-2000 *Installation of underground utility services and pipelines within railway boundaries* (see further discussion below);
- ARTC Standards EGS00 to EGS07 (old G5000) available from www.artc.com.au;
- Railway of Australia (ROA) – Code of installation; and
- AS/NZS 2566.2:2002 *Buried flexible pipelines - Installation*.

The pipeline corridor would cross the Main Southern Railway three times as well as the Goulburn Crookwell Railway and the Moss Vale Unanderra Railway. Construction in the vicinity of the railway line would be undertaken by thrust boring which involves excavating an entry and exit point either side of the railway line and boring under the railway line to install the pipeline. AS 4799-2000 *Installation of underground utility services and pipelines within railway boundaries* (Accessed 21 December 2009) describes the procedures for undertaking railway crossings and other work within the rail corridor. The AS 4799-2000 requirements for installing the pipeline under the railway are as follows:

- Services and pipelines would be located so as to cross the tracks as close to 90° as practicable; however, it is considered preferable to have a greater oblique angle than to introduce bends within the railway reserve;
- Wherever practicable, crossings will not be in wet or rocky terrain or where deep cuts are required;
- Services and pipelines would be laid at least 3 m clear of all railway structures, cattle pits and stops, drains, signalling equipment, overhead masts, poles, underground cables, buildings, points and crossings, bridges and culverts;
- Unless otherwise agreed, permanent pits and access chambers would not be located within 6 m of the toe of banks or top of cuttings, nor within 10 m of the nearest rail. Design loads shall be as approved by the Corporation;
- Pipeline routes, cable routes, carrier pipes and encasing pipes would be separated by a clear spacing of at least 600 mm in the horizontal plane from other pipelines and from power and communication cables, unless agreed to otherwise, in writing, by the parties;
- For pipelines crossing under railway tracks, the length of pipe designed to withstand the railway loading would extend to at least 1 m beyond the toe of the embankment or cutting, or for a minimum distance from the nearest rail, as appropriate, whichever is greater;
- When considering the length of pipe designed to withstand the railway loading, consideration would be given to the likelihood of future works within the reserve;
- Where site conditions permit, the installation would be by boring for the portion under the tracks and at least 3 m beyond the outer rails or 3 m beyond the toe of embankment, whichever is the further;
- Where services or pipes are installed by boring, the diameter of the bored hole would not exceed the outside diameter of the pipe, service or encasing pipe, and any coating by more than 50 mm;

- Where the diameter of the bored hole exceeds the outside diameter of the pipe by more than 50 mm or where it is necessary to abandon a bored hole, prompt remedial measures shall be taken to provide support for the railway and the hole would be backfilled in accordance with the standards;
- Excavated material would not be disposed of directly onto the track ballast. Material from excavations would be deposited in such a manner that it is kept clear of track ballast so as to avoid fouling of ballast and blocking of track or other surface drainage;
- All open excavations under tracks and for a distance of at least 3 m beyond the outer rails, and including the whole of any embankment, would be backfilled and compacted with approved finely crushed rocks, sand, gravel or other approved materials to at least 95% of maximum modified dry density, as determined in accordance with AS 1289 (all parts), for the top 1 m as measured from formation level, and to at least 90 per cent of maximum modified dry density for the remainder of the open excavation;
- Ballast would be reinstated to the satisfaction of the Corporation; and
- Markers would be located above or adjacent to the buried cable or pipeline; at points of entering and leaving the property of the ARTC at changes of direction; at distances between consecutive markers of the lesser of 200 m or line of sight; at all drains or other points of potential hazard; and where specified, at the ends of the under track crossing (the end of the under track crossing is taken as the point 3 m beyond the outer rail or toe of the embankment).

Waterway crossings

The NOW (December, 2009) provides the following guidelines in relation to undertaking waterway crossings:

- Crossings of waterways/riparian land should be underbored or attached to existing structures (such as bridges) to avoid direct impacts on the aquatic and riparian environment, where:
  - there is permanent flow in the waterway; or
  - there is existing native riparian vegetation; or
  - the creek is in good natural condition; or
  - there is a potential fish passage Class 1 or 2.
- The NOW recommends that underboring commence from the outer edge of the riparian land and that it is bored for the full width of the watercourse and riparian land;
- Trenching may be an option if:
  - the waterway is a dry intermittent creek;
  - the native riparian vegetation has previously been cleared; and
  - there are no watercourse instability issues.
- If there are areas of the existing creek instability below the pipeline route the creek crossing needs to be designed so as to ensure for the future stability of the waterways and reduce risk to the pipeline itself.

Each waterway that would be crossed by the pipeline has been classified in the Environmental Assessment in general accordance with the parameters set out in Table 6.3. The waterways were classified into Major, Moderate, Minor and Drainage Line to help prioritise the fieldwork undertaken and identify where more significant constraints may occur.

Table 6.3 Waterway Crossing Classification Descriptions

Waterway Classification	Catchment Area (ha)	Stream Order*	Valley/Channel Definition
Minor Waterway	< 20	Unmapped to first order	No defined channel and valley floor fill < 10 metres wide
Moderate Waterway	20 to 100	First to second order	Defined channel and/or valley floor fill > 10 metres wide.
Major Waterway	> 100	Second order and higher	Defined channel and/or valley floor fill > 10 metres wide.

* Based on Department of Lands 1:25,000 drainage layer

The type and geomorphic condition of waterways at each crossing location was defined using the River Styles framework (Brierley and Fryirs, 2005).

The method for crossing each waterway has been determined based on the waterway classification, the type and geomorphic condition of the waterways at the crossing location as well as the environmental sensitivity of the waterway. The proposed waterway crossings for the main waterways have been listed in Table 6.5 to Table 6.10. Further details are provided in the Geomorphology Assessment (GHD, 2010) provided in Appendix I.

The majority of the waterways have been classified as either minor or moderate waterways and would be crossed by open trenching. Twenty-one named waterways would be crossed by the pipeline. The preferred crossing method for each has been listed in Table 6.4. Details on the classification of each waterway can be found in Chapter 15.

Most of the moderate and minor waterways would be crossed by trenching methods that, even if flows occur during construction, would not completely stop the flow or impede fish passage (see Section 6.7.2). The crossings of the Wollondilly River, Paddys River, Narambulla Creek, Kenmore Creek (W120), Kellys Creek , the Uringalla Creek and Back Creek Confluence and Jaorimin Creek would be crossed, at this stage, by horizontal directional drilling (or other under-boring technique). The method for construction across these waterways in particular would be further refined during the detailed design phase after topographic surveys have been completed to determine the preferred method of crossing. Further aquatic ecology surveys, ~~in particular~~ to assess the potential for fish barriers and other impacts to aquatic species, and geotechnical surveys would also be undertaken during detailed design to determine the preferred crossing method.

Where the crossings are to be trenched, the stability of the waterway will be used (see Table 6.4) to determine the depth of the trench required so that future bed instability issues will not expose the pipeline. Through watercourses, depending on the depth to bedrock, the trench could be excavated up to 2.5 m below ground level with 1 to 2 meters of material between the top of the pipeline and the channel bed; however the requirement in most cases is likely to be significantly less. Most of the systems along the pipeline are comprised of fine-grain material and thus the instability associated with a mobile bed is greatly reduced. The one sand system (W69 – Jaorimin Creek) identified along the pipeline is proposed to be underbored. Mitigation measures will be employed on valley fill and channelized fill waterways to prevent instabilities from occurring.

Table 6.4 Determination of waterway crossing method

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W1	Unnamed	Minor	Intermittent	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W2	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	**Low - moderate**	Underbore	Trenching	Fragile waterway (Valley Fill). Low-moderate risk of increasing bank instability. See mitigation measures in Section 15.5.
W3	Kellys Creek	Major	**Perennial**	Low Sinuosity Fine Grained	Moderate	No	Low	Underbore	HDD	HDD due to perennial flow^
W4	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W5	Unnamed	Minor	Intermittent	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W6	Unnamed	Minor	Intermittent	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W7	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W8	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	**Low - moderate**	Underbore	Trenching	Fragile waterway (Valley Fill). Existing headward erosion. See mitigation measures in Section 15.5.
W9	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W10	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W11	Unnamed	Drainage Line	Intermittent	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W12	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W13	Unnamed	Drainage Line	Intermittent	Channelised Fill	Poor	No	Low	Trenching	Trenching	-
W14	Medway Rivulet	Moderate	Ephemeral	Low Sinuosity Fine Grained	Poor	No	Low	Trenching	Trenching	-
W15	Unnamed	Minor	Ephemeral	Channelised Fill	Poor	No	Low	Trenching	Trenching	-
W16	Unnamed	Minor	Ephemeral	Low Sinuosity Fine Grained	Moderate	No	Low	Trenching	Trenching	-
W17	Unnamed	Drainage Line	Intermittent	Channelised Fill	Poor	No	Low	Trenching	Trenching	-
W18	Unnamed	Minor	Ephemeral	Channelised Fill	Poor	No	Low	Trenching	Trenching	-
W19	Wells Creek	Minor	Ephemeral	Channelised Fill	Poor	No	**Low - moderate**	Underbore	Trenching	Low-moderate risk of increasing bank instability. See proposed mitigation measures in Section 15.5.
W20	Unnamed	Drainage Line	Intermittent	Channelised Fill	Poor	No	Low	Trenching	Trenching	Existing headward erosion. See mitigation measures in Section 15.5.
W21	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W22	Black Bobs Creek	Moderate	Ephemeral	Low Sinuosity Fine Grained	Moderate	No	Low	Trenching	Trenching	-
W23	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W24	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W25	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W26	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes**	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching. Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W27	Long Swamp Creek	Minor	Ephemeral	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W28	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	**Yes**	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.
W29	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W30	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W31	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W32	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching. Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W33	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W34	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	No	Low	Trenching	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W35	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W36	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W37	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W38	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W39	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W40	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W41	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W42	Unnamed	Drainage Line	Intermittent	**Valley Fill**	**Good**	**Yes***	**Low-moderate**	Underbore	Trenching	Fragile waterway (Valley Fill) in good condition. Evidence of headward erosion upstream. See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W43	Unnamed	Drainage Line	Intermittent	**Valley Fill**	**Good**	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill) in good condition. See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W44	Unnamed	Drainage Line	Intermittent	**Valley Fill**	**Good**	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill) in good condition. See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W45	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W46	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W47	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W48	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W49	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W50	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W51	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W52	Paddys River	Major	**Perennial**	Bedrock Controlled Fine Grained	Moderate	**Yes***	Low	Underbore	HDD	HDD due to perennial flow^
W53	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W54	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W55	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W56	Uringalla Creek	Major	**Perennial**	Low Sinuosity Fine Grained	Moderate	**Yes***	Low	Underbore	HDD	HDD due to perennial flow^
W57	Back Creek	Major	**Perennial**	Low Sinuosity Fine Grained	Moderate	**Yes**	Low	Underbore	HDD	HDD due to perennial flow^
W58	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W59	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W60	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W61	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W62	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W63	Unnamed	Drainage Line	Intermittent	**Valley Fill**	**Good**	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. The creek is in good natural condition however it is an intermittent drainage line which is located adjacent to the existing gas pipeline. Some native vegetation present which would be removed during trenching. Thus, trenching has been proposed for this crossing.
W64	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Some native vegetation present which would be removed during trenching. Thus, trenching has been proposed for this crossing.
W65	Unnamed	Drainage Line	Intermittent	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W66	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W67	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	**Low-moderate**	Underbore	Trenching	Evidence of existing headward erosion. Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W68	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W69	Jaorimin Creek	**Major**	Perennial	Bedrock Controlled Sand	**Good**	**Yes***	**Low-moderate**	Underbore	HDD	HDD due to perennial flow, vegetation and good condition bedrock controlled sand river style which ^ Downstream of rock crossing/weir – eroding banks are present with potential for weir failure.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W70	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	No	Low	Trenching	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W71	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	No	Low	Trenching	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing.
W72	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W73	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.
W74	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.
W75	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.
W76	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W77	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W78	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W79	Unnamed	Minor	Intermittent	Channelised Fill	Poor	No	**Low - moderate**	Underbore	Trenching	Low – moderate risk of increasing bank instability. See mitigation measures in Section 15.5.
W80	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	**Low - moderate**	Underbore	Trenching	Low – moderate risk of increasing headward erosion. Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W81	Lockyersleigh Creek	Minor	Ephemeral	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W82	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W83	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W84	Narambulla Creek	**Major**	**Perennial**	**Chain of Ponds**	Moderate	No	Low	Underbore	HDD	HDD due to perennial flow^ Fragile waterway (Chain of Ponds). See mitigation measures in Section 15.5.
W85	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See mitigation measures in Section 15.5.
W86	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W87	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W88	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.
W89	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W90	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W91	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W92	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W93	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.
W94	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W95	Osborns Creek	Moderate	Ephemeral	Confined	Moderate	**Yes***	Low	Underbore	Trenching	Some native vegetation present which would be removed during trenching.
W96	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W97	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W98	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W99	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W100	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W101	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W102	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W103	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	**Yes***	Low	Underbore	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5. Some native vegetation present which would be removed during trenching.
W104	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W105	Wollondilly River	Major	**Perennial**	Bedrock Controlled Fine Grained	Moderate	**Yes***	Low	Underbore	HDD	-

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W106	Wollondilly River	Major	**Perennial**	Bedrock Controlled Fine Grained	Moderate	No	Low	Underbore	HDD	-
W107	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W108	Boxers Creek	**Major**	**Perennial**	Channelised Fill	Poor	No	**Low - moderate**	Underbore	Trenching	Channelised fill river style in poor condition, incised to bedrock. Although there are some low-moderate instability risks, trenching is considered an appropriate method the creek does not convey permanent water (although considered perennial). Therefore, trenching is proposed.
W109	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W110	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W111	Unnamed	Minor	Intermittent	Channelised Fill	Poor	No	**Low-moderate**	Underbore	Trenching	Low-moderate risk of increasing bank instability. See proposed mitigation measures in Section 15.5.
W112	Unnamed	Moderate	Ephemeral	Low Sinuosity Fine Grained	Poor	No	Low	Trenching	Trenching	-
W113	Unnamed	Minor	Intermittent	Channelised Fill	Poor	No	Low	Trenching	Trenching	-
W114	Unnamed	Minor	Intermittent	Channelised Fill	Poor	No	Low	Trenching	Trenching	-

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W115	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes**	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W116	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes***	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W117	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W118	Unnamed	Drainage Line	Intermittent	Headwater	**Good**	**Yes**	Low	Underbore	Trenching	The creek is in good natural condition however it is an intermittent, headwater drainage line which is a stable, resilient geomorphic stream type and is located adjacent to the existing gas pipeline. Thus, trenching has been proposed for this crossing. Some native vegetation present which would be removed during trenching.
W119	Wollondilly River	Major	**Perennial**	Bedrock Controlled Fine Grained	Moderate	**Yes***	Low	Underbore	HDD	HDD due to perennial flow^
W120	Kenmore Creek	Major	**Perennial**	Low Sinuosity Fine Grained	Moderate	**Yes***	Low	Underbore	HDD	HDD due to perennial flow^
W121	Unnamed	Moderate	Intermittent	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W122	Kenmore Creek	Moderate	Ephemeral	Low Sinuosity Fine Grained	Moderate	No	Low	Trenching	Trenching	-
W123	Kenmore Creek	Moderate	Ephemeral	Low Sinuosity Fine Grained	Poor	No	Low	Trenching	Trenching	-
W124	Kenmore Creek	Moderate	Intermittent	**Valley Fill**	Poor	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W125	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W126	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W127	Unnamed	Drainage Line	Intermittent	Channelised Fill	Moderate	No	Low	Trenching	Trenching	-
W128	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W129	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W130	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W131	Wollondilly River	Major	**Perennial**	Bedrock Controlled Fine Grained	Moderate	**Yes**	Low	Underbore	HDD	HDD due to perennial flow^
W132	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W133	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.

Waterway ID	Waterway name	Class[1]	Flow frequency	River Style[2]	Geomorphic condition[3]	Native riparian vegetation present[4]	Risk of inducing / increasing instability	NOW recomm. crossing method[5]	GHD proposed crossing method	Comment
W134	Unnamed	Minor	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W135	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.
W136	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W137	Unnamed	Drainage Line	Intermittent	Headwater	Moderate	No	Low	Trenching	Trenching	-
W138	Unnamed	Drainage Line	Intermittent	**Valley Fill**	Moderate	No	Low	Trenching	Trenching	Fragile waterway (Valley Fill). See proposed mitigation measures in Section 15.5.

Notes:

1 Based on geomorphic classification (Geomorphology Assessment - Appendix I).

2 Based on the River Styles framework, Brierley and Fryirs, 2005.

3 Based on Outhet and Cook (2004) who describe a rapid method of condition assessment that frames geomorphic condition in the context of natural and human induced variability and divide stream condition into three broad categories: Good, Moderate and Poor.

4 Based on field work observations and aerial photograph analysis.

* Native vegetation present in riparian zone however located directly adjacent to existing cleared easement.

^ Further aquatic ecology surveys and geotechnical investigations during detailed design will determine final crossing method.

6.5.3 Crossing point locations

The pipeline traverses a number of roads, railways and waterways between the Wingecarribee Reservoir and Goulburn. The pipeline would cross 68 roads including RTA roads, local Council roads, rural roads and unnamed roads; five railways and approximately 21 named waterways. Most of the roads and waterways would be crossed by trenching; however all the railway crossings, all RTA roads and some major rivers would be crossed by alternative methods. The crossing points for each road, railway and waterway within the sectors between the Wingecarribee Reservoir and Goulburn are listed in Table 6.5 to Table 6.10 and shown in Figure 6.10 to Figure 6.25.

Table 6.5 Crossings located in the Glenquarry & Werai – Moss Vale Sector

Site ID	Name	Chainage	Primary crossing method
Roads			
ROAD 1	Unnamed Road 1	23	Trenched
ROAD 2	Unnamed road 2	47	Trenched
ROAD 3	Sheepwash Road	839	Thrust boring
ROAD 4	Unnamed Road 4	2 969	Trenched
ROAD 5	Iona Park Road	5 787	Trenched
ROAD 6	Illawarra Highway (Robertson Road)	7 607	Thrust boring
ROAD 7	Unnamed Road 7	9 557	Trenched
ROAD 8	Yarrawa Road	10 074	Trenched
ROAD 9	Unnamed Road 9	10 256	Trenched
ROAD 10	Unnamed Road 10	10 729	Trenched
ROAD 11	Bibbys Lane	12 101	Trenched
ROAD 12	Mount Broughton Road	12 769	Trenched
Railway			
RAIL 1	Moss Vale Unanderra Railway	4 566	Thrust boring
RAIL 2	Main Southern Railway	13 873	Thrust boring
Waterways			
W3	Kellys Creek	3 178	Horizontal directional drilling
W14	Medway Rivulet	13 607	Trenched

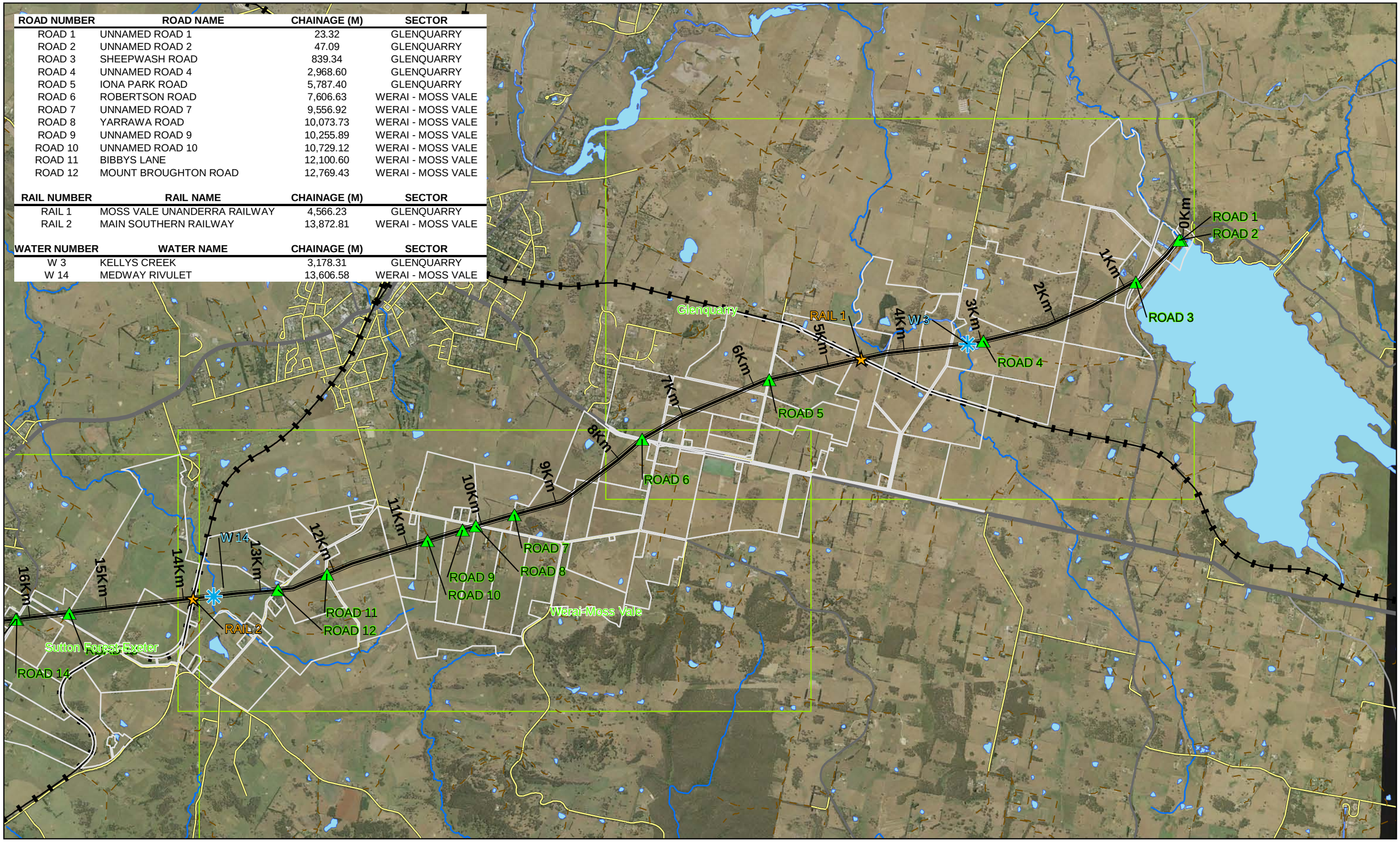
Figure 6.10 Moss Vale – Unanderra Railway crossing point

Figure 6.11 Main Southern Railway Crossing Point No. 1

ROAD NUMBER	ROAD NAME	CHAINAGE (M)	SECTOR
ROAD 1	UNNAMED ROAD 1	23.32	GLENQUARRY
ROAD 2	UNNAMED ROAD 2	47.09	GLENQUARRY
ROAD 3	SHEEPWASH ROAD	839.34	GLENQUARRY
ROAD 4	UNNAMED ROAD 4	2,968.60	GLENQUARRY
ROAD 5	IONA PARK ROAD	5,787.40	GLENQUARRY
ROAD 6	ROBERTSON ROAD	7,606.63	WERAI - MOSS VALE
ROAD 7	UNNAMED ROAD 7	9,556.92	WERAI - MOSS VALE
ROAD 8	YARRAWA ROAD	10,073.73	WERAI - MOSS VALE
ROAD 9	UNNAMED ROAD 9	10,255.89	WERAI - MOSS VALE
ROAD 10	UNNAMED ROAD 10	10,729.12	WERAI - MOSS VALE
ROAD 11	BIBBYS LANE	12,100.60	WERAI - MOSS VALE
ROAD 12	MOUNT BROUGHTON ROAD	12,769.43	WERAI - MOSS VALE

RAIL NUMBER	RAIL NAME	CHAINAGE (M)	SECTOR
RAIL 1	MOSS VALE UNANDERRA RAILWAY	4,566.23	GLENQUARRY
RAIL 2	MAIN SOUTHERN RAILWAY	13,872.81	WERAI - MOSS VALE

WATER NUMBER	WATER NAME	CHAINAGE (M)	SECTOR
W 3	KELLYS CREEK	3,178.31	GLENQUARRY
W 14	MEDWAY RIVULET	13,606.58	WERAI - MOSS VALE



1:45,000 (at A3)

0 500 1,000 1,500 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Proposed Route (29/11/2009)
- Properties Intersected By Corridor
- Pipeline Water Intersection
- Pipeline Road Intersections
- Pipeline Railway Intersection
- River/Creek
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Track-Vehicular
- UrbanServiceLane
- GMC / WSC LGA Boundary
- Sector boundary
- HydroArea

CLIENTS | PEOPLE | PERFORMANCE

Goulburn Mulwaree Council
Highlands Source Project

Road, Rail and Water Intersections Along Pipeline Sector: Werai - Glenquarry

Job Number	23-13312
Revision	0
Date	09 FEB 2010

Figure 6.12

G:\23\13312\GIS\ArcView\Wkspace\EAFigures\23_13312_EA_Crossings_RevC.mxd

Data Source: NSW Lands Dept: roadsegments, railways,hydroarea, hydroline - 2007; GMC: aerial imagery - 2008; GMC/WSC: Cadastral data - 2009. Created by: ccharalambou

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com.au **W** www.ghd.com.au

Table 6.6 Crossings located in the Sutton Forest – Exeter Sector

Site ID	Name	Chainage	Primary crossing method
Roads			
ROAD 13	Unnamed Road 13	15 486	Trenched
ROAD 14	Unnamed Road 14	16 169	Trenched
ROAD 15	Exeter Road	16 182	Trenched
ROAD 16	Unnamed Road 16	16 620	Trenched
ROAD 17	Unnamed Road 17	19 210	Trenched
ROAD 18	Old Argyle Road	19 720	Trenched
ROAD 19	Sallys Corner Road	24 989	Trenched
ROAD 20	Middle Road	25 089	Trenched
ROAD 21	Unnamed Road 21	25 157	Trenched
ROAD 22	Hume Highway	26 383	Thrust boring
ROAD 23	Hume Highway	26 417	Thrust boring
Railway			
-	-	-	-
Waterways			
W19	Wells Creek	19 438	Trenched
W22	Black Bobs Creek	20 793	Trenched
W27	Long Swamp Creek	24 503	Trenched

Figure 6.13 Hume Highway Crossing No. 1

Figure 6.14 Hume Highway Crossing No. 2

ROAD NUMBER	ROAD NAME	CHAINAGE (M)	SECTOR
ROAD 13	UNNAMED ROAD 13	15,486.18	SUTTON FOREST - EXETER
ROAD 14	UNNAMED ROAD 14	16,168.58	SUTTON FOREST - EXETER
ROAD 15	EXETER ROAD	16,181.60	SUTTON FOREST - EXETER
ROAD 16	UNNAMED ROAD 16	16,619.56	SUTTON FOREST - EXETER
ROAD 17	UNNAMED ROAD 17	19,209.93	SUTTON FOREST - EXETER
ROAD 18	OLD ARGYLE ROAD	19,719.76	SUTTON FOREST - EXETER
ROAD 19	SALLYS CORNER ROAD	24,989.30	SUTTON FOREST - EXETER
ROAD 20	MIDDLE ROAD	25,089.38	SUTTON FOREST - EXETER
ROAD 21	UNNAMED ROAD 21	25,156.62	SUTTON FOREST - EXETER
ROAD 22	HUME HIGHWAY	26,382.71	SUTTON FOREST - EXETER
ROAD 23	HUME HIGHWAY	26,417.13	SUTTON FOREST - EXETER

WATER NUMBER	WATER NAME	CHAINAGE (M)	SECTOR
W 19	WELLS CREEK	19,438.19	SUTTON FOREST - EXETER
W 22	BLACK BOBS CREEK	20,793.24	SUTTON FOREST - EXETER
W 27	LONG SWAMP CREEK	24,503.07	SUTTON FOREST - EXETER

1:45,000 (at A3)

0 500 1,000 1,500 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Proposed Route (29/11/2009)
- Properties Intersected By Corridor
- Pipeline Water Intersection
- Pipeline Road Intersections
- Pipeline Railway Intersection
- River/Creek
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Track-Vehicular
- UrbanServiceLane
- GMC / WSC LGA Boundary
- Sector boundary
- HydroArea

CLIENTS | PEOPLE | PERFORMANCE

Goulburn Mulwaree Council
Highlands Source Project

Road, Rail and Water Intersections Along Pipeline Sector: Sutton Forest-Exeter

Job Number	23-13312
Revision	0
Date	09 FEB 2010

Figure 6.15

G:\23\13312\GIS\ArcView\Wkspace\EAFigures\23_13312_EA_Crossings_RevC.mxd

Data Source: NSW Lands Dept: roadsegments, railways,hydroarea, hydroline - 2007; GMC: aerial imagery - 2008; GMC/WSC: Cadastral data - 2009. Created by: ccharalambou

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com.au **W** www.ghd.com.au

Table 6.7 Crossings located in the Paddys River Sector

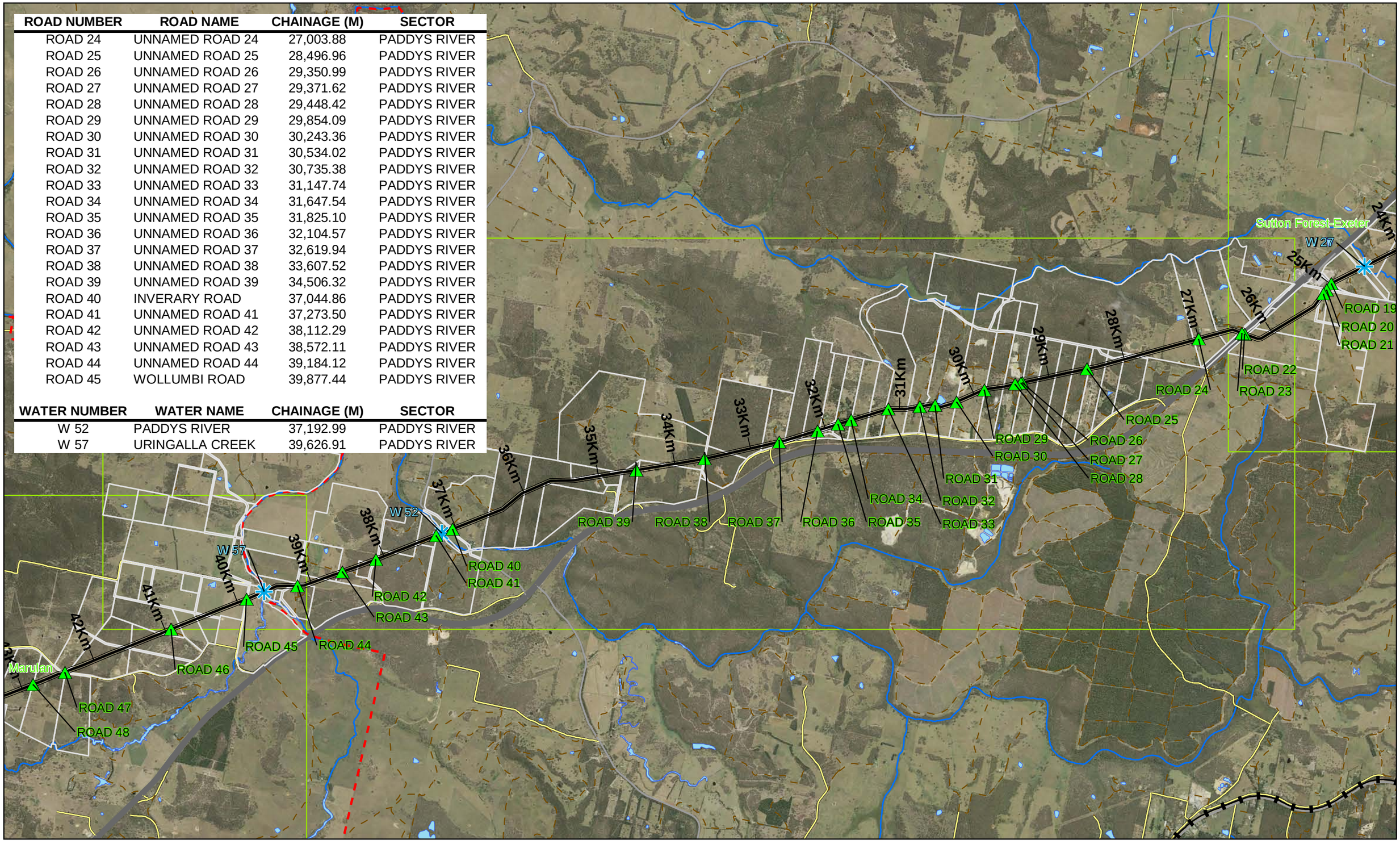
Site ID	Name	Chainage	Primary crossing method
Roads			
ROAD 24	Unnamed Road 24	27 004	Trenched
ROAD 25	Unnamed Road 25	28 497	Trenched
ROAD 26	Unnamed Road 26	29 351	Trenched
ROAD 27	Unnamed Road 27	29 372	Trenched
ROAD 28	Unnamed Road 28	29 448	Trenched
ROAD 29	Unnamed Road 29	29 854	Trenched
ROAD 30	Unnamed Road 30	30 243	Trenched
ROAD 31	Unnamed Road 31	30 534	Trenched
ROAD 32	Unnamed Road 32	30 735	Trenched
ROAD 33	Unnamed Road 33	31 148	Trenched
ROAD 34	Unnamed Road 34	31 648	Trenched
ROAD 35	Unnamed Road 35	31 825	Trenched
ROAD 36	Unnamed Road 36	32 105	Trenched
ROAD 37	Unnamed Road 37	32 620	Trenched
ROAD 38	Unnamed Road 38	33 608	Trenched
ROAD 39	Unnamed Road 39	34 506	Trenched
ROAD 40	Inverary Road	37 045	Trenched
ROAD 41	Unnamed Road 41	37 274	Trenched
ROAD 42	Unnamed Road 42	38 112	Trenched
ROAD 43	Unnamed Road 43	38 572	Trenched
ROAD 44	Unnamed Road 44	39 184	Trenched
ROAD 45	Wollumbi Road	39 877	Trenched
Railway			
-	-	-	-
Waterways			
W52	Paddys River	37 193	Horizontal directional drilling

Site ID	Name	Chainage	Primary crossing method
W56	Uringalla Creek	39 627	Horizontal directional drilling
W57	Back Creek	39 627	Horizontal directional drilling

Figure 6.16 Paddys River crossing point

ROAD NUMBER	ROAD NAME	CHAINAGE (M)	SECTOR
ROAD 24	UNNAMED ROAD 24	27,003.88	PADDYS RIVER
ROAD 25	UNNAMED ROAD 25	28,496.96	PADDYS RIVER
ROAD 26	UNNAMED ROAD 26	29,350.99	PADDYS RIVER
ROAD 27	UNNAMED ROAD 27	29,371.62	PADDYS RIVER
ROAD 28	UNNAMED ROAD 28	29,448.42	PADDYS RIVER
ROAD 29	UNNAMED ROAD 29	29,854.09	PADDYS RIVER
ROAD 30	UNNAMED ROAD 30	30,243.36	PADDYS RIVER
ROAD 31	UNNAMED ROAD 31	30,534.02	PADDYS RIVER
ROAD 32	UNNAMED ROAD 32	30,735.38	PADDYS RIVER
ROAD 33	UNNAMED ROAD 33	31,147.74	PADDYS RIVER
ROAD 34	UNNAMED ROAD 34	31,647.54	PADDYS RIVER
ROAD 35	UNNAMED ROAD 35	31,825.10	PADDYS RIVER
ROAD 36	UNNAMED ROAD 36	32,104.57	PADDYS RIVER
ROAD 37	UNNAMED ROAD 37	32,619.94	PADDYS RIVER
ROAD 38	UNNAMED ROAD 38	33,607.52	PADDYS RIVER
ROAD 39	UNNAMED ROAD 39	34,506.32	PADDYS RIVER
ROAD 40	INVERARY ROAD	37,044.86	PADDYS RIVER
ROAD 41	UNNAMED ROAD 41	37,273.50	PADDYS RIVER
ROAD 42	UNNAMED ROAD 42	38,112.29	PADDYS RIVER
ROAD 43	UNNAMED ROAD 43	38,572.11	PADDYS RIVER
ROAD 44	UNNAMED ROAD 44	39,184.12	PADDYS RIVER
ROAD 45	WOLLUMBI ROAD	39,877.44	PADDYS RIVER

WATER NUMBER	WATER NAME	CHAINAGE (M)	SECTOR
W 52	PADDYS RIVER	37,192.99	PADDYS RIVER
W 57	URINGALLA CREEK	39,626.91	PADDYS RIVER



1:45,000 (at A3)

0 500 1,000 1,500 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Proposed Route (29/11/2009)
- Properties Intersected By Corridor
- Pipeline Water Intersection
- Pipeline Road Intersections
- Pipeline Railway Intersection
- River/Creek
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Track-Vehicular
- UrbanServiceLane
- GMC / WSC LGA Boundary
- Sector boundary
- HydroArea

CLIENTS | PEOPLE | PERFORMANCE

Goulburn Mulwaree Council
Highlands Source Project

Road, Rail and Water Intersections Along Pipeline Sector: Paddys River

Job Number	23-13312
Revision	0
Date	09 FEB 2010

Figure 6.17

G:\23\13312\GIS\ArcView\Wkspace\EAFigures\23_13312_EA_Crossings_RevC.mxd

Data Source: NSW Lands Dept: roadsegments, railways,hydroarea, hydroline - 2007; GMC: aerial imagery - 2008; GMC/WSC: Cadastral data - 2009. Created by: ccharalambou

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com.au **W** www.ghd.com.au