4. Environmental impacts and safeguards

4.1 Geology and soils

4.1.1 Soil types

With reference to the 1:250 000 Singleton Soil Landscape Sheet, soil landscapes along the proposed pipeline route include:

Liddell

The majority of the pipeline passes through the Liddell Soil Landscape. The Liddell landscape is underlain by the Singleton Coal Measures which consist of lithic sandstones, shale, siltstone and coal. These soils are generally residual materials derived from *in-situ* weathering of parent rock and some colluvium.

Topographically, this soil landscape is characterised by undulating low hills and hills with gradients of between 4 and 7%. Soils consist of sand and sandy loam topsoils underlain by sandy clay loam and sandy clay. Soil depths are shallow on erosional upper slopes at approximately 0.5 m and moderately deeper on lower depositional slopes, generally >1 m.

High soil salinity is also a characteristic. And as a result, minor to severe sheet erosion is common in this landscape. The dispersive nature of the soils also leads to moderate gully and rill erosion. Some gravely soils are also evident on mid slopes.

Geotechnical issues that will require managing during construction and operation of the pipeline as a result of the nature of the soils include:

- Drilling difficulties are expected in areas with gravely soils.
- The shallow depth to rock may impact on horizontal drilling.
- Moderate to severe gully and sheet erosion is expected in cleared areas or where dispersive soils are found. Erosion will require controlling during and after any earthworks.
- Highly saline soils may impact on concrete and steel structures.

Brays Hill

The pipeline traverses the Brays Hill Soil Landscape for approximately 1.25 km along the most western portion. This soil landscape is characterised by rounded, low, undulating hills with grades of between 6 to 10%. The soil landscape is underlain by Singleton Coal Measures and Tertiary basalt. Soils are residual forming from *in-situ* parent rock and some colluvium.

Soil depths are variable ranging from <0.5 m to >1 m and consist of clay and clay loam, underlain by sandy clay and clay. Minor sheet erosion is common on hill slopes following clearing and minor gully erosion is evident in drainage lines. Soils tend to have low salinity; however, highly reactive soils are common. The depth to the water table is variable and maybe between 0.5 m to >1 m.

Geotechnical issues that will require managing during construction and operation of the pipeline as a result of the nature of the soils include:

- Drilling difficulties are expected in areas with shallow depths to rock.

- Minor gully and sheet erosion is expected in cleared areas. Erosion will need to be controlled during and after any earthworks.
- Saturated soils may have low wet bearing strengths.
- High water tables may require dewatering.
- Clay soils may exhibit shrink/swell characteristics with fluctuating moisture contents.

Hunter

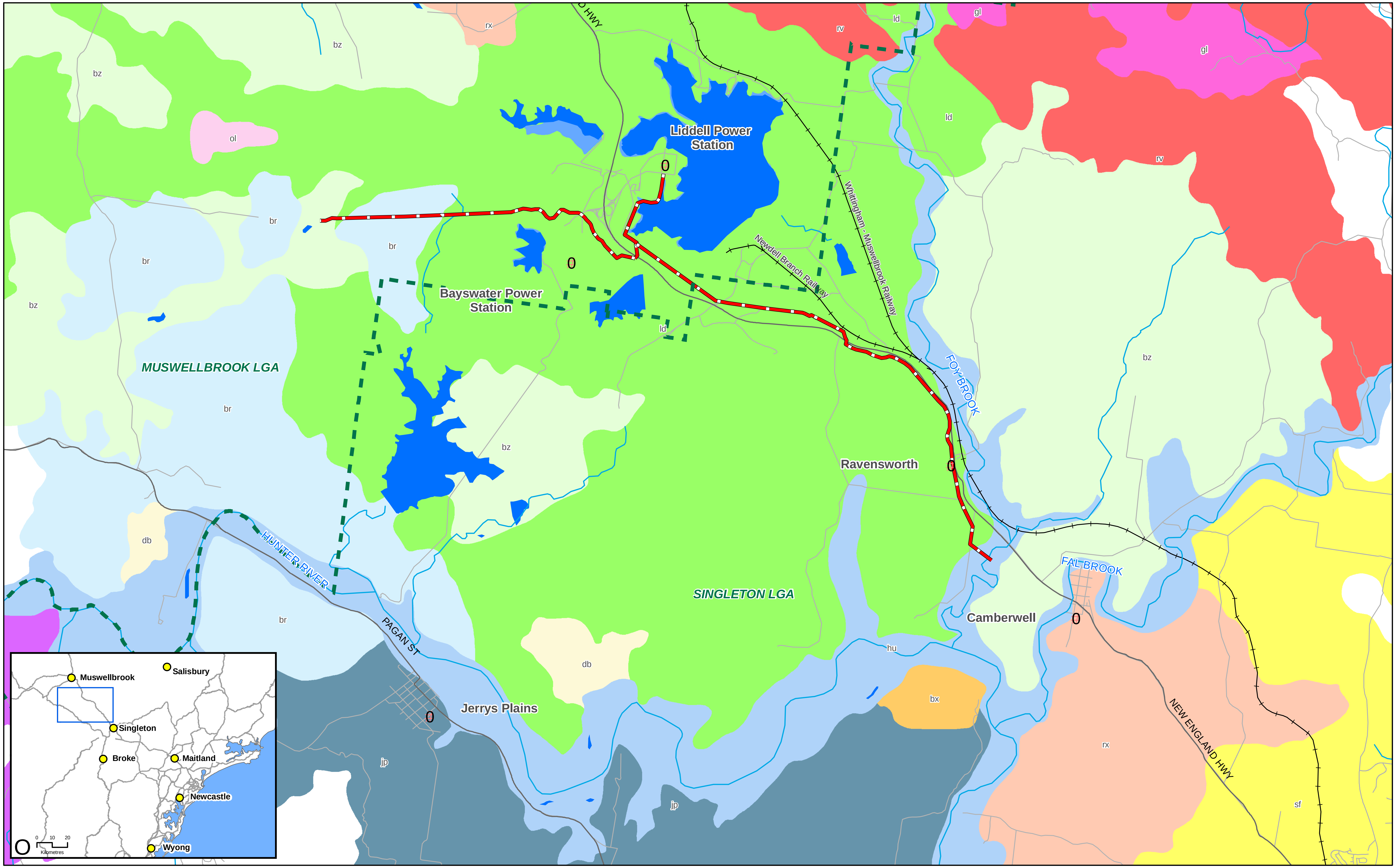
The southern most section of the pipeline borders the Hunter River Soil Landscape though this landscape is unlikely to be encountered.

The Hunter Soil Landscape is predominantly alluvial and is located on the level plains and river terraces of the Hunter River. Topographically the landscape is characterised by slopes with grades of between 0 and 3%. Soils consist of alluvial loams and sand underlain by sandy, clay loam, sand, gravel and clay. Lithic sandstone and shale can be found on upper terraces.

Minor stream bank erosion occurs around the river and minor sheet and gully erosion is present on terraces. Soil profiles are generally deep with depth to rock generally between 1 and 3 m. Shallower soil profiles may be expected on upper terraces. High water tables are a feature of this landscape and may be expected at approximately 1 m depth. Clay soils are expected to be highly reactive and flood hazard is high. Gravely soils are also common.

The resultant geotechnical issues are:

- Drilling difficulties are expected in areas with shallow or gravely soils.
- Minor gully and sheet erosion is expected. Erosion will require controlling during and after any earthworks.
- High water tables may require dewatering.
- Saturated soils may have low wet bearing strengths.
- Clay soils may exhibit shrink/swell characteristics with fluctuating moisture contents.
- A high flood hazard exists which may result in inundation and scouring of soils.



0 2,000
METRES

PDF Address: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS\Maps\Month_Year\0809_Sept

PDF File: 2122755C_2008_Soil_Landscape

Localities
Drainage
Proposed Pipeline
Local Government Boundary

Soil Landscape

Bayswater (bz)	Dartbrook (db)	Liddell (ld)	Sedgefield (sf)
Benjang (bj)	Greenland (gl)	Ogilvie (ol)	
Branxton (bx)	Hunter (hu)	Rosevale (rv)	
Brays Hill (br)	Jerrys Plains (jp)	Roxburgh (rx)	

PARSONS BRINCKERHOFF

Title: Geology Soil Mapping	Datum: MGA 94 / Zone 56	Scale: 1:90,000	
Project: Gas Supply Pipeline	Drawn: VB	Date: 24 Sept 2008	
Client: Macquarie Generation	Designed: VB	Date: 24 Sept 2008	
Proj. No. 2122755C	Layout Size: A3	Checked: AC	Date: 24 Sept 2008
GIS Proj: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS	DWG. No: 2008	Fig. No. 4.1	

4.1.2 Contamination

Existing environment

Due to the historic and existing land use along the proposed pipeline route, some locations are potentially contaminated. The region has a history of agriculture, mining, mining-related and rural residential activities. Soils may be contaminated with chemicals such as herbicides, pesticides, oils, flocculants and heavy metals as a result of a range of current and previous activities.

Potential impacts

There is a potential for impact on human health and the environment from various contaminants during construction activities. Significance of impact is dependant on the type of contaminant, its concentration, length and type of exposure.

Mitigation measures

Due to the long linear nature of the proposed pipeline route, it is impractical and cost prohibitive to collect and analyse soil along the entire length of the route for contaminants. All spoil will be stockpiled on site and handled as per the CEMP.

All stockpiles will be stabilised as soon as practicable in accordance with the principles outlined in Section 4.1.4.

4.1.3 Potential acid sulfate soil

Existing environment

Acid sulphate soil (ASS) maps of the area (NSW Department of Land and Water Conservation, 1997) indicate that there are no known occurrences of ASS in the study area. Therefore, exposure of local soils to the atmosphere should not create sulphuric acid.

Potential impacts

There are no foreseen potential impacts as the ASS maps indicated that there are no known occurrences of ASS in the study area.

Mitigation measures

No mitigation measures are proposed as it is unlikely that ASS would occur in the study area.

4.1.4 Erosion and sediment control

Existing environment

The majority of the proposed route is located along previously cleared and disturbed land.

Potential impacts

Activities such as vegetation clearing, excavating and storage of spoil, and movement of machinery, have the potential to trigger erosion and sediment issues.

Mitigation measures

An erosion and sediment control plan (ESCP) will be developed as part of the CEMP to ensure appropriate erosion and sediment control is in place during and post-construction. The ESCP will be reviewed by Macquarie Generation and will include:

- Encase pipeline trenching in creeks with concrete, backfill with compacted excavated material and place aggregate over backfilled material.
- Minimise site disturbance and ensure machinery and vehicle access to the site is via specific entrances.
- Install sediment fences and/or hay bales or turf strips downslope of construction, storage and disturbed areas, and in other strategic locations where there is the potential for impacts on watercourses.
- Locate stockpiles away from drainage lines and upslope of sediment control structures.
- Construct diversion banks and/or catch drains to protect stockpiles and bare earth areas from erosion by surface flows.
- Stabilise disturbed areas by seeding as soon as practicable after completion of formation works.
- Maintain and monitor erosion control measures.

These mitigation measures have been based on ‘Managing Urban Stormwater – Soils and Construction (2004) published by LandCom’.

4.1.5 Mine subsidence

The area contains several historical and current open-cut and underground coal mines. Underground coal mining has the potential to create subsidence that may result in cracking and/or sinking of the ground surface. Subsidence may cause variations in the morphology of the terrain along the pipeline route that has the potential to cause cracking or other physical damage to the pipe.

Mitigation measures

Suitable engineering controls will be integral to the design of the pipeline to ensure that the potential for subsidence is considered and ameliorated. The options for pipeline material of polyethylene or fibreglass have been selected as they are appropriate in areas affected by mine subsidence. Detailed engineering design will further consider potential impacts of subsidence. The risk assessment conducted by Sleeman Consulting (2008) provides the following recommendations for subsidence.

Key mechanisms for dealing with the effects of subsidence include the following:

- In the course of detailed pipeline design appropriately qualified specialists will be engaged to prepare subsidence predictions. The predictions will be taken into account to design pipeline configurations that minimise the impact of subsidence. For example, ‘snaking’ of the pipeline across areas of subsidence (to reduce induced gradients and stresses) is possible.
- During the operating phase, if mining activity takes place below the pipeline and subsidence could occur, induced stresses will be monitored and management regimes implemented as necessary to ensure the integrity of the gas pipelines is not compromised. For example, should predetermined stress limits be reached during

subsidence, action can be taken to prevent the limit from being exceeded. The most reliable approach to dealing with flexural strains is to expose and then raise or lower portions of the pipeline to reduce curvature. This can be done without taking the pipeline out of service.

In addition, Macquarie Generation will confer with the Mine Subsidence Board to develop an ongoing pipeline management plan. Risks associated with the impact of subsidence on the proposed gas pipeline are readily manageable through design and ongoing monitoring initiatives (Sleeman Consulting, 2008).

4.2 Surface hydrology and riparian restoration

4.2.1 Surface hydrology

Existing environment

The Hunter River catchment is one of the largest in NSW covering an area of approximately 22,000 km^2. Originating in the Mount Royal Range, the Hunter River is 300 km long and enters the sea at Newcastle. The tidal limit is located 4 km upstream of Maitland at Oakhampton, 45 km from the sea (DECC, 2007c). The pipeline crosses Tinkers Creek, Bayswater Creek and Bowmans Creek as shown in Figure 4-2 a-d.

Riparian vegetation in the study area includes Dry Woodland and Forests vegetation communities. The creek crossings occur in riparian vegetation including for Bayswater Creek no significant riparian vegetation, Tinkers Creek crossing occurs in Central Hunter Swamp Oak Forest and Bowmans Creek crossing occurs in Hunter Valley River Oak Forest.

In considering the location and crossing method of these Creeks, a number of publications were considered and are discussed below.

The *NSW State Rivers and Estuaries Policy* (NSW Water Resources Council, 1993) recognises the importance of rivers and estuaries and the potential for declining condition. Appropriate controls have been proposed to mitigate any adverse impact on watercourses. LWRRDC (2000) prepared *A Rehabilitation Manual for Australian Streams* to help professional managers involved in rehabilitating the physical and biological condition of Australian streams. The manual is divided into the four main topics of rehabilitation concepts, a planning procedure for rehabilitating streams, typical stream problems and a range of tools that could be used for rehabilitation (LWRRDC, 2000). Although the manual is generally useful for rehabilitating streams, the general principles have been considered when selecting appropriate watercourse crossing points.

Several methods for crossings watercourse and implementing associated environmental controls have been selected. Most of the watercourses to cross are ephemeral grassy drainage lines. For ephemeral drainage lines, an open trench will be dug with a backhoe. The Tinkers Creek, Bayswater Creek and Bowmans Creek's crossing will be completed using directional drilling under-boring to avoid disturbing the banks or riparian vegetation.

Potential impacts

Open trenching through ephemeral grassy drainage lines and creek underboring construction activities have the potential to impact water quality in a number of ways if not appropriately managed. These impacts include chemical spills or disturbance of contaminated sediments; changes to drainage line morphology due to excavation resulting in increased sediment loads and discharges from stockpiled material.

Mitigation measures

Appropriate environmental controls must be implemented during pipeline construction and operation to ameliorate the potential for any adverse impact on watercourses. The CEMP must consider all watercourse crossings and is likely to include the following issues:

- Trenching through creek and drainage lines will only be undertaken during dry periods to avoid increase in erosion and sedimentation.
- Following excavation the surface profile of the drainage line will be restored to pre-construction levels, to ensure the natural surface hydrology is not disturbed.
- Permanent watercourses will be completed using directional drilling under-boring to avoid disturbing the banks or riparian vegetation.
- All erosion and sedimentation control measures such as sediment traps, hay bales and silt traps be put in place to protect the water quality of the drainage lines and creeks. These devices should be routinely checked and maintained to provide satisfactory performance as per the ESCP outlined in Section 4.1.4.
- Chemicals used during construction of the pipeline are stored within appropriately bunded areas.
- Chemical unloading is conducted in appropriately bunded areas.
- Emergency Spill Kits be kept on site and kept at hand for any refuelling or transferring activities.
- Ensuring construction staff are trained adequately and can:
  - Conduct regular inspections of valves, pumps, pipes and hoses.
  - Use preventative maintenance.
  - Use standard operating procedures in the event on an on-site or off-site emergency.
  - Isolate a tank or bund.
  - Stop substances entering the environment once they have escaped.
- Post construction site stabilisation and erosion control audits will be undertaken.

4.2.2 Groundwater

Existing environment

The *NSW State Groundwater Policy Framework Document* (date) seeks to manage the State's groundwater resources to sustain environmental, social and economic use for the people of NSW. The NSW *Groundwater Quality Protection*, *Groundwater Quantity Management* and *Groundwater Dependent Ecosystems* policies form the three components of the Framework Document, which in turn comprises the State Groundwater Policy (DLWC, 1997).

Groundwater along the pipeline route ranges in depth from shallow in areas near watercourses and the Hunter River, to several metres deep in higher topographic areas. Groundwater is also subject to local variations based on geology of the substrata. The pipeline will have a minimum cover of 750 mm, at which depth it is unlikely that groundwater will be encountered for the majority of the route. There is no available information on the transmission zones in the vicinity of the creek crossings.

Potential impacts

Where groundwater is encountered the pipe material, both fibreglass and polyethylene, will not be susceptible to corrosion. Construction and operation of the pipeline has the potential to impact on groundwater. Potential groundwater contamination may occur through allowing contaminants to enter or leach into the groundwater, particularly in transmissions zones, and adequate controls must be in place to mitigate impact. There may also be the potential for leachate to enter surface waters or drain from excavations.

Mitigation measures

The depth of excavation is such that groundwater is unlikely to be encountered. Where groundwater is encountered the following mitigation measures are appropriate:

- Dewatering excavations, if required, using spear points installed around the perimeter of each excavation.
- Collecting groundwater using spear points, assessing it in accordance with the *Environmental Guidelines: Assessment, classification and management of liquid and non-liquid wastes* (NSW Environmental Protection Agency, 1999), and managing its disposal accordingly.

4.3 Flora and fauna

4.3.1 Background

Biosis Research was commissioned previously to conduct a terrestrial flora and fauna assessment for the original proposed pipeline route (north-south route) that included this current east-west route. The results of the previously biological surveys and assessment have been incorporated within a revised assessment report provided in Appendix F.

The revised report examines the existing flora and fauna assemblages and their habitats along the current pipeline route, and determines the potential impacts of construction and operation of the project on those features. It summarises the proposed mitigation measures as well as the impact assessments required under the *Environmental Planning and Assessment Act 1979* and the *Environment Protection and Biodiversity Conservation Act 1999*.

The Director General requirements specifically identified the need for the proposal to consider and assess the impacts on the endangered ecological community, Warkworth Sands Woodlands. This requirement specifically relates to an area of the Warkworth Sands Woodlands adjoining the previous North-south pipeline route. No remnants of Warkworth Sands Woodland are present within the subject site or study area of the currently proposed East-west pipeline, subject to this assessment. As such Warkworth Sands Woodland is not considered further by this assessment.

The proposed pipeline route is largely restricted to existing highly disturbed environments associated with road and electricity easements, post mine rehabilitation and cleared agricultural lands. These disturbed areas incorporate approximately 93% of the study area. The pipeline route does however, cross small areas of native vegetation that contain natural vegetation communities, some of which are considered to be rare or Threatened. These areas consist of approximately 2.8 ha of vegetation, which represents 0.03% of the native vegetation within the locality.

- Threatened species and communities and migratory species – Potential impact of the proposal on flora and fauna is discussed in Section 4.5. The ecological assessment concluded that with the implementation of appropriate mitigation measures the proposal is unlikely to have a long-term impact on threatened species and/or populations within the study area (DEWR, 2007).

4.3.2 Field surveys

Field surveys of the study area were carried out between 25 and 29 July 2007 (Biosis Research 2007) and 14 and 17 July 2008 (Parsons Brinckerhoff (PB)). The surveys sought primarily to assess the extent and condition of vegetation communities and potential flora and fauna habitat, especially for Threatened species. Sites surveyed included the proposed construction footprint and surrounding areas potentially affected by the construction of the project.

Survey effort and design considered the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (Department of Environment and Conservation 2004), and included the following:

- targeted flora surveys for Threatened species (quadrat and random meander)
- fauna habitat assessment
- spotlighting
- bat call detection
- call playback
- incidental diurnal and nocturnal observations.

4.3.3 Identified vegetation communities

The detailed field surveys identified that the majority of the study area was dominated by highly modified and/or artificial vegetation communities commonly associated with mine site rehabilitation and a rural landscape. Six natural communities were identified as small largely isolated remnants adjoining the proposed alignment. One preliminary listed Endangered Ecological Community, Hunter Lowland Redgum Forest (HLRF) was identified within the study area.

Table 4-1 Significance and condition of vegetation communities identified in the study area

Vegetation Community (this study)	Significance after (Peake 2005)	Condition
Central Hunter Box - Ironbark Woodland- NS	Not regionally significant	Moderate to Low
Central Hunter Spotted Gum Box Ironbark Open Forest	Regionally Significant (threatened and poorly reserved)	Moderate to Low
Hunter Lowland Redgum Forest (EEC)	EEC/ Regionally Significant (threatened)	Moderate to Low
Central Hunter Swamp Oak Forest	Regionally Significant	Moderate to Low

Vegetation Community (this study)	Significance after (Peake 2005)	Condition
	(restricted, very highly cleared, highly threatened)	
Hunter Valley River Oak Forest	Regionally Significant (restricted, very highly cleared, under threat)	Moderate to Low
Narrabeen Footslopes Slaty Box Woodland	Regionally Significant (restricted distribution)	Moderate to Low
Planted Rehabilitation Scrub-Open Forest	Not regionally significant	Poor (highly disturbed)
Derived Grassland	Not regionally significant	Poor (highly disturbed)

4.3.4 Endangered ecological communities

Hunter Lowland Redgum Forest is listed as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995* and is present in the northwest of the study area as a small remnant patch associated with an unnamed drainage line of Tinkers creek. Impact assessments concluded that the project is not likely to have a significant impact on this community, nor will it interfere with their recovery, assuming suitable mitigation measures are put in place.