# QSN Link Pipeline

# Environmental Impact Report

(South Australia)

Document No. Q-02-102-LAE-G-001, Revision 1

December 2007

# Contents

# Appendices



# Figures



# Tables

# Plates

# 1 Introduction

## 1.1 Background

Epic Energy Queensland Pty Ltd (Epic Energy) proposes to construct and operate an underground gas pipeline, the QSN Link, from Ballera in south west Queensland to Moomba in north-eastern South Australia. The pipeline will be approximately 180 km long. It will transport sales quality gas from the Bowen/Surat basin in eastern Queensland (via the existing South West Queensland Pipeline) and deliver it to the Moomba to Adelaide Pipeline (MAP) and the Moomba to Sydney (MSP).

## 1.2 About this Document

This Environmental Impact Report (EIR) has been prepared to satisfy the requirements of the *Petroleum Act 2000*, with regards to the construction, operation and decommissioning of the South Australian section of the QSN Link. This document:

- outlines legislative approvals required for the project (Section 2)
- provides a description of the project (Section 3)
- discusses the rationale for the project and alternatives considered (Section 4)
- describes the specific features of the environment that are reasonably expected to be affected by pipeline construction and operation, identifies potential environmental impacts and consequences and proposes measures to mitigate potential environmental impacts (Section 5)
- describes the proposed environmental management framework for the project (Section 6)
- summarises stakeholder consultation (Section 7).

A Statement of Environmental Objectives (SEO) has also been developed in conjunction with this EIR. It outlines the environmental objectives that the project is required to achieve and the criteria upon which the objectives are to be assessed. The SEO has been developed on the basis of the information provided in this EIR.

## 1.3 Project Proponent

Epic Energy is one of Australia's largest gas transmission companies. It is the owner /operator of the Moomba to Adelaide Pipeline System and the South-East Pipeline System in South Australia, the Pilbara Energy Pipeline in Western Australia and the South West Queensland Pipeline (SWQP). Epic Energy's gas customers include electricity generators, gas distribution companies and industrial users.

Epic Energy will construct, own and operate the pipeline. Pipeline construction activities will be carried out by specialist contractors under Epic Energy's direct supervision. Epic Energy is also employing specialist advisors in the engineering / design, environmental and regulatory approvals, cultural heritage and native title fields.

## 1.4 Environmental Commitment

Epic Energy is committed to responsible environmental management for the construction and operation of the proposed pipeline and believes that any potential adverse environmental effects can be effectively managed in a manner that complies with the requirements of this document, as well as:

- all relevant State and Commonwealth laws and regulations
- Epic Energy's Environmental Policy (see Appendix 1)
- relevant industry standards (e.g. Australian Standard AS2885: Pipelines – Gas and Liquid Petroleum)
- the Australian Pipeline Industry Association (APIA) *Code of Environmental Practice – Onshore Pipelines* (APIA 2005).

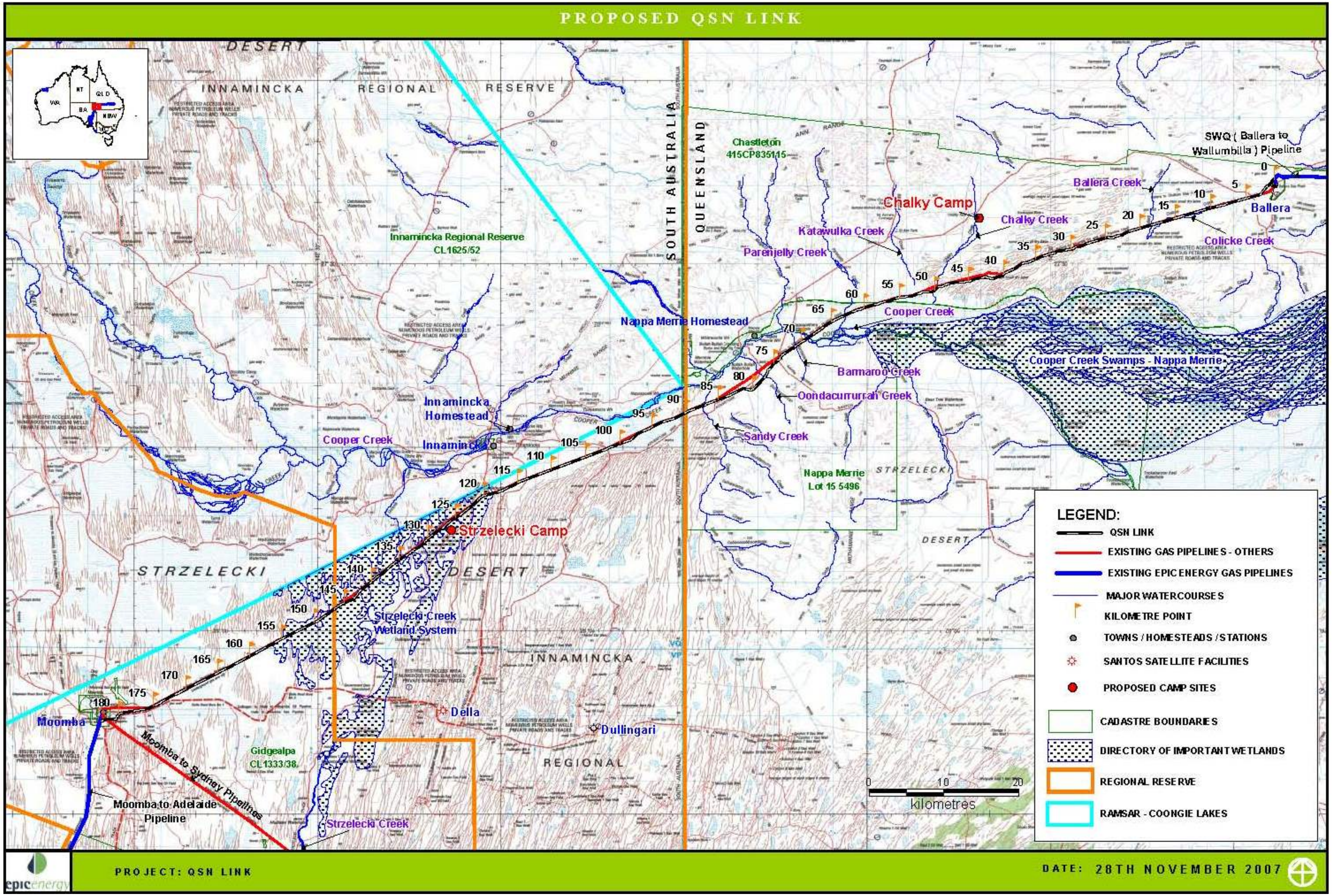



**Figure 1: Location of QSN Link**

# 2 Legislative Framework

The major approval required for the pipeline in South Australia is a Pipeline Licence under the South Australian *Petroleum Act 2000*. The project may also be subject to additional approvals under South Australian and Commonwealth legislation, as discussed in the following sections.

The Queensland section of the QSN Link also requires a Pipeline Licence under the Queensland *Petroleum and Gas (Production and Safety) Act 2004* and an Environmental Authority under the *Environmental Protection Act 1994*. These approvals are dealt with in separate documentation.

## 2.1 Petroleum Act

The South Australian *Petroleum Act 2000* (the Act) requires that a Statement of Environmental Objectives (SEO) and an Environmental Impact Report (EIR) be prepared to support the application for a Pipeline Licence. The SEO has been prepared as a separate document to this EIR.

The requirements are set out in the following sections of the Act and the *Petroleum Regulations 2000* (the Regulations):

- the Environmental Impact Report must be prepared in accordance with
    - Section 97 of the Act, which requires the EIR to take into account cultural, amenity and other values relevant to the assessment, risks to public health and safety of regulated activities, and to contain sufficient information to make an informed assessment of the likely environmental impact of the activities possible.
    - Regulation 10 of the Regulations, which requires the EIR to include descriptions of activities and environmental features which may be affected, assessment of possible affects on cultural values and public health and safety, identification and assessment of consequences of potential environmental hazards, and details of consultation.

- the Statement of Environmental Objectives must be prepared in accordance with sections 99 and 100 of the Act and regulations 12 and 13.

Once the Pipeline Licence application, the EIR and the SEO are submitted, Primary Industries and Resources South Australia (PIRSA) conduct a significance assessment and classify the activities as low, medium or high impact. This determines the level of consultation required prior to final approval of the SEO.

- Low impact activities do not require public consultation, and an SEO may be approved after internal government consultation
- Medium impact activities require a public consultation process for the EIR and SEO, with comment sought for at least 30 business days.
- High impact activities are required to be assessed under the provisions of the *Development Act 1993*.

Once the approval process is complete all documentation, including the EIR and SEO, must be entered on an environmental register. This public register resides on the PIRSA internet site so that community access is readily available, which facilitates openness, transparency and accountability in the decision making process (McDonough 2000).

It is a requirement of the Petroleum Act that all regulated activities are conducted in accordance with an approved SEO.

## 2.2 Commonwealth Legislation

### 2.2.1 Environment Protection & Biodiversity Conservation Act

The Commonwealth *Environment Protection and Biodiversity and Conservation Act 1999* (EPBC Act) protects matters of "national environmental significance" including World Heritage properties, National heritage places, Ramsar wetlands of international importance, listed threatened species and ecological communities and migratory species.

Based on current knowledge and previous pipeline projects, Epic Energy believes that a requirement for approval under the Act is not likely to be triggered. This will be formally confirmed with submission of a referral.

### 2.2.2 Native Title Act

Under the Commonwealth *Native Title Act 1993*, indigenous land rights may exist in areas such as vacant or unallocated crown land, some reserve lands, some types of pastoral lease and waters that are not privately owned. Native title can be extinguished by certain actions (for example where the land is held under freehold title or registered as a road reserve).

The majority of the land on the pipeline route is under pastoral lease, where native title has not been extinguished. Consequently, the native title process will be undertaken in accordance with the legislative requirements under the Native Title Act, in full consultation with native title claimants and regulatory agencies.

There is an active native title claim that covers the South Australian section of the route, the Yandruwandha/Yawarrawarrka Native Title Claim (Native Title Tribunal file number SC98/1). There is currently no active registered claim for the Queensland section of the route, however claims have previously been lodged by the Wangkumarra People and registration of future claims over the area is possible.

Epic Energy has, and will continue to, consult with native title claimant groups and other relevant Aboriginal groups regarding Aboriginal cultural heritage issues, as discussed in Section 5.5.2.

## 2.3 Additional Approvals

A range of other legislation is relevant to the proposed pipeline and a number of additional approvals may be required for pipeline construction as outlined in Table 1. It is noted that not all of these approvals would be required or sought (e.g. EPA approval for trench water disposal to inland waters).

**Table 1: Additional Legislation and Possible Subsequent Approvals**

| Legislation | Activity | Agency |
|---|---|---|
| **South Australia** | | |
| *Natural Resources Management Act 2004* | Approval to source water<br>(Note: Under Section 5.2.4 of the Catchment Water Management Plan for the SA Arid Lands Region, 'water affecting activities' conducted under a SEO approved under the Petroleum Act do not require a permit) | Dept of Water Land & Biodiversity Conservation (DWLBC) |
| *Native Vegetation Act 1991* | Permission to disturb or remove native vegetation (integrated into SEO approval) | Native Vegetation Group, Dept of Water Land & Biodiversity Conservation (DWLBC) |
| *National Parks and Wildlife Act 1972* | Activities within Regional Reserves<br>Handling protected fauna | Department for Environment & Heritage (DEH) |
| *Aboriginal Heritage Act 1988* | Permission to disturb/destroy Aboriginal relic | Aboriginal Affairs & Reconciliation Division, Dept of Premier & Cabinet |
| *Heritage Places Act 1993* | Permission to disturb/destroy archaeological relic | Department for Environment & Heritage (DEH) |
| *Environment Protection Act 1993* | General duty to prevent environmental harm<br>Disposal of trench water to inland waters | Environment Protection Authority (EPA) |
| **Commonwealth** | | |
| *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* | Permission to disturb/destroy archaeological areas or objects | Department of the Environment & Water Resources (DEWR) |

### 2.3.1 Native Vegetation Act

The South Australian *Native Vegetation Act 1991* and the *Native Vegetation Regulations 2003* apply to vegetation clearance for petroleum pipeline construction. Under Regulation 5(1)(zd), petroleum pipeline projects are permitted to clear native vegetation, provided that either:

- the clearance is undertaken in accordance with a SEO and the Native Vegetation Council has signified that, as a result of work undertaken in accordance with the SEO, there will be a 'significant environmental benefit' (SEB) at the site of the operations or within the same region of the State, or
- the project makes a payment into the Native Vegetation Fund of an amount considered by the Native Vegetation Council to be sufficient to achieve a 'significant environmental benefit'.

A 'significant environmental benefit' is typically achieved by undertaking works to establish, regenerate, preserve or maintain native vegetation.

The assessment process under this provision has not been finalised. It may eventually involve delegation of Native Vegetation Council powers to PIRSA under a set of guidelines, however the Native Vegetation Council is currently required to be involved.

In accordance with Regulation 5(1)(zd), the SEO incorporates the requirement to achieve a SEB. Appendix 2 of this EIR discusses the proposed SEB calculation methods, with reference to the SEB guidelines (DWLBC 2005).

The exact amount of vegetation cleared for pipeline construction depends on a number of factors that cannot be precisely determined at this stage (e.g. construction easement width, extent of areas where easement is narrowed, size and area of permanent facilities or access tracks). Consequently, it is proposed that a final SEB obligation be calculated after construction of the pipeline, in consultation with the Native Vegetation Council.

## 2.4 Easements and Land Tenure

Epic Energy requires easements (or the highest possible level of tenure available, such as licences or sub-leases in Crown land parcels) over the land traversed by the pipeline to ensure that the company's assets are adequately protected. Under the arrangement the property owner retains title to the land. The easement provides rights of access for monitoring and maintenance and prevents certain land uses (such as construction of permanent buildings) from occurring over the pipeline. The occupier of the land will also retain the rights to conduct pastoral activities over the easement.

Epic Energy also proposes to acquire a either a freehold or leasehold interest in land to accommodate end of line facilities at Moomba and Ballera together with appropriate rights to access these facilities.

Epic Energy has engaged specialist property consultants, Maloney Field Services, to negotiate land tenure arrangements and any compensation payments with all land owners and occupiers on the ultimate pipeline route.

Epic Energy is confident of being able to agree terms and conditions for relevant land tenure with land owners. In the cases where the negotiation process fails to result in an agreeable resolution to both parties, the *Acquisition of Land Act 1967* (Queensland) and the *Land Acquisition Act 1969* (South Australia) provide a process to compulsorily acquire the relevant interest in the land.

# 3 Project Details

The QSN Link project involves the construction and operation of an underground gas transmission pipeline from Ballera in south west Queensland to Moomba in north-eastern South Australia. The purpose of the pipeline is to allow transport sales quality gas to be transported from eastern Queensland to southern Australian gas markets in South Australia and New South Wales via the existing South West Queensland Pipeline (SWQP) which extends from Wallumbilla to Ballera.

The QSN Link will allow coal seam methane gas from the Bowen/Surat Basin to be backhauled through the existing SWQP, through the QSN Link pipeline and into the Moomba to Sydney Pipeline (MSP) and Moomba to Adelaide Pipeline (MAP) at Moomba, independently of the Cooper Basin gas production facilities.

## 3.1 Pipeline Route

The QSN Link pipeline will extend from the Ballera Gas facility in Queensland and head in a south-westerly direction. It will pass approximately 7 km to the south of Innamincka in South Australia and terminate at the Moomba plant. The pipeline will be some 180 km in length, with approximately 88.5 km in Queensland and 91.5 km in South Australia (refer Figure 1).

For most of the route, the QSN Link will be adjacent to the existing Santos pipeline, which carries gas and liquids from Ballera to Moomba. In general, the QSN Link pipeline is expected to be approximately 50 m to the south of the Santos pipeline, however deviations of up to several hundred metres from the Santos pipeline will occur in several locations, to achieve optimal alignment through areas of sand dunes and features such as Aboriginal heritage sites.

## 3.2 Project Timing

Pipeline construction activities are planned to commence in April 2008. Construction is expected to take approximately eight months, with first gas in January 2009. The majority of the pipeline installation is expected to be completed by August 2008 with hydrostatic testing and drying currently scheduled to occur in August and September 2008.

Subject to finalisation of environmental approvals and issue of pipeline licences it is anticipated that mobilisation for pipeline construction will commence in early April 2008. This planning may be subject to change if extensive flooding of the Cooper Creek system results from high summer rainfall in its catchment in Queensland.

The pipeline terminal stations at Ballera and Moomba, together with hot taps of the SWQP at Ballera and the MAP and MSP at Moomba are scheduled to take place from early May 2008 to the end of September 2008. Pre-commissioning and commissioning activities will be carried out from September 2008 to November 2008 to allow gas flows to commence in January 2009.

The schedule is dependent upon the timing of all required regulatory approvals.

The design life of the pipeline has not been finalised but is expected to be in the order of 50 years.

## 3.3 Design and Engineering

The pipeline would be typical of a modern, small to medium diameter gas transmission pipeline. Final design parameters are yet to be determined, but it is likely to involve the following infrastructure:

- a buried, high pressure, steel, natural gas pipeline, with a diameter in the order of 400 mm.
- an inlet meter station at Ballera
- above ground facilities at intervals along the pipeline including a mid-line mainline valve, cathodic protection systems and marker signs
- an outlet delivery station at Moomba.

The pipeline will be designed in accordance with the requirements of *AS 2885 Pipelines – Gas and Liquid Petroleum*. Key engineering and design features of the pipeline are provided in Table 2.

**Table 2: Indicative Pipeline Engineering and Design Features**

| Design Element | Details |
|---|---|
| Length | Approximately 180 km (91.5 km in SA) |
| Diameter | 400mm |
| Wall Thickness | 8.1 mm (standard), 9.7 mm (heavy walled) |
| Factory Coating | Trilaminate with heat shrink joint coating |
| Pipeline Content | Sales quality gas |
| Operational Pressure | 15.3 MPa |
| Maximum Allowable Operating Pressure | 15.3 MPa |
| Nominal Capacity | 112 TJ/day<br>(at nominal 9 MPa Ballera inlet pressure and 7 MPa at Moomba) |
| Design Capacity | 270 TJ /day |
| Standard Construction Easement Width | 25-30 m (narrowed in sensitive areas where possible) |
| Minimum Depth of Cover | In accordance with AS 2885.1, typically:<br>Cross country sections – 750 mm<br>Beneath roads and watercourses – 1200 mm<br>Heavy industrial location classifications – 1200 mm |
| Corrosion Protection | External coating and impressed current cathodic protection |
| Non Destructive Testing | 100% radiography of welded joints. Hydrostatic pressure testing of completed pipeline to 1.25 x operating pressure. |
| Buried Marker Tape | Installed at crossings, throughout Heavy Industrial Secondary Land Classification adjacent to Moomba and Ballera and other risk areas as defined in the Risk Assessment. |
| Pipeline monitoring system | SCADA system for remote monitoring and control of all facilities along the pipeline. |

A brief description of the pipeline facilities and associated infrastructure is provided in Table 3. The facilities will be designed in accordance with all relevant legislation and standards.

All stations will utilise solar power with battery back-up and provision for connection to diesel power backup. All stations will be surrounded by security fencing and built above the 100 year flood level.

The construction of the facilities is likely to take approximately 2 – 3 months. The facility compounds will be permanent for the lifetime of the pipeline.

**Table 3: Indicative Pipeline Facilities and Infrastructure**

| Facility | Description |
|---|---|
| Inlet Metering Station | An inlet metering station will be installed at Ballera to take receipt of gas from the SWQP and deliver into the new QSN Pipeline. The meter station will include flow measurement, emergency isolation and pigging equipment. The new inlet station will be connected to the existing SWQP by installation of a hot tap. |
| Outlet Delivery Station | An outlet delivery station will be installed at Moomba to deliver gas into the Moomba to Adelaide Pipeline (MAP) and the Moomba to Sydney Pipeline (MSP). The station will consist of a pig receiver, emergency isolation, filtration, power supply and separate custody transfer metering and pressure regulation to each site. Provision for future connection of heaters will be supplied. Connection to the MAP and MSP will be by hot tap. |

| Facility | Description |
|---|---|
| Mainline Valve (MLV) | A midline MLV will be installed at approximately Kilometre Point 101 which will comprise of a single actuated MLV and a bypass which will include a pressure regulator to reduce pressure downstream of the MLV, reducing the required pressure cut at Moomba.<br>MLVs typically occupy a fenced and gravelled area of approximately 200 $m^2$ and are located on the pipeline easement. |
| Cathodic Protection and Stray Current Earthing System | A cathodic protection system is incorporated into the pipeline design to protect the pipeline from corrosion. This involves the use of buried anode beds, which are connected to the pipeline via cabling. In addition, cathodic protection test posts are located approximately every 2 km. The test posts are required to allow for monitoring of the effectiveness of the corrosion protection system. |
| SCADA System | A SCADA (Supervisory Control and Data Acquisition) system for remote monitoring and control of all facilities along the pipeline will be installed comprising of Remote Telemetry Units (RTUs) connected to the Epic Energy's Transportation Services Control Centre (TSCC) via Satellite Communication. |
| Pipeline Markers | Pipeline marker signs are located at intervals along the pipeline easement in accordance with AS 2885, so that a person can clearly see a marker sign in either direction. The maker signs are placed closer at bends, on either side of road and watercourse crossings and at fence lines. |

**Plate 1: A Mainline Valve compound**

## 3.4 Construction

The proposed pipeline will be constructed in accordance with the requirements of AS 2885 and the Australian Pipeline Industry Association *Code of Environmental Practice – Onshore Pipelines* (APIA 2005).

<u>Construction Workforce</u>

It is expected that a workforce of approximately 200 will install the pipeline, with up to 30 additional personnel involved in contractor and project management and facilities installation. Personnel will be transported to and from site by company vehicles.

<u>Construction Camps</u>

The construction workforce will be accommodated in temporary camps and at local accommodation (e.g. Santos facilities). Two preliminary campsite locations have been selected, which will accommodate a single camp that will be mobilised from one location to the other during the construction phase of the project. The preliminary camp site locations are near Kilometre Point (KP) 124 in South Australia, which was used as a campsite for the Santos pipeline from Ballera to Moomba and near KP 35 in Queensland, off the Adventure Way/Cooper Creek Road. The camps will be located in clear or disturbed areas and clearance of trees for the camp will be avoided.

The temporary camp is likely to have footprint of approximately 300m x 200m. This will encompass accommodation units for approximately 200 persons, a mess, and recreation huts. Sewage is likely to be treated by a transportable sewage treatment unit (e.g. enviroflow or equivalent - see http://www.enviroflow.com.au).

The water supply for the camp is likely to be obtained from Santos (e.g. from the Moomba RO plant), but may be obtained from existing bores or the Cooper Creek if it is flowing, subject to required approvals. Bore water or Cooper Creek water may require treatment to render it suitable for camp use.

Construction Depot

Construction depots will be required during construction. They will typically be co-located with the construction camps and will be relocated as pipeline construction progresses. Existing cleared areas or industrial areas (e.g. at Moomba) will be used where appropriate.

The construction depot will be primarily used for equipment and vehicle storage, site office and administration centre, training depot, and a rendezvous point for the crew each morning prior to commencing works on the easement. Equipment stored at the construction depot may include:

- construction vehicles
- diesel fuel and lubricants
- vehicle maintenance equipment
- sand bags, sediment fencing, star droppers and wooden stakes
- pipe wrapping and joint coating materials
- pipe.

Pipe and other construction equipment will be delivered to the construction depot and lay-down areas by long-haul trucks. Typically most construction vehicles and machinery will be secured in the construction depot overnight and during construction cycle breaks.

The construction depots will be sited to minimise or where possible avoid the clearance of native vegetation. The sites will be restored to pre-existing condition or better at the completion of construction works. Waste recycling and disposal, spill response and depot maintenance will be carried out in accordance with procedures outlined in Section 5.9.5.

Access

Equipment and personnel will require regular access to right-of-way and work sites during construction. Access will generally be via existing roads and tracks as well as the construction right-of-way. There are a number of public roads, Santos roads and station tracks in the region and these are likely to be sufficient for construction access, however it is possible that some new access tracks will need to be created. Existing access roads and tracks will be used wherever practicable and all project related movements will be restricted to approved access tracks, the right-of-way and identified turnaround or lay-down areas.

Access planning will include consultation with all relevant landholders and regulatory authorities. New access tracks will avoid environmentally sensitive areas and will be situated to minimise disturbance to landholders. All temporary access tracks will be rehabilitated in accordance with landowner requirements.

### 3.4.1 Construction Activities

Construction activities will follow standard industry practice and are described in the following sections. Key design elements are listed in Table 4.

**Table 4: Pipeline Construction**

| Design Element | Details |
|---|---|
| Construction right-of-way width | Typically 25-30 m |
| Construction workforce (approximately) | 200 |
| Standard construction hours | 0630 – 1900, 7 days/week |
| Construction duration (approximately) | 6-8 months |
| Refuelling | Fuel truck (refilled at construction depot)<br>Spill containment equipment will be available on vehicle |
| Length of open trench | Typically up to 30 km, may vary either side of this number depending on construction progress |
| Expected time between clear and grade and restoration (approximately) | Typically 2 to 3 months, however in dune fields it may be 4-6 months to allow access |

Detailed Survey

Engineering, environmental and cultural heritage surveys are used both in route selection and to determine if any special construction techniques or mitigation measures are required. Once the pipeline route has been determined, the centreline is surveyed and engineering aspects are finalised. Markers (pegs) are placed along the entire route to identify the pipeline route and right-of-way.

Fencing

Fences are severed and replaced with temporary construction gates. This involves a fencing crew and associated vehicles accessing the pipeline route via the surveyed right-of-way (usually prior to its clearing) and associated access tracks (pre-existing where practicable). Depending upon the property size and number of fences, fencing should be completed within a week on each property.

Clear and Grade

Graders and bulldozers are used to clear the right-of-way of vegetation and topsoil ready for construction to commence. Vegetation and topsoil is stockpiled separately on the right-of-way. Topsoil will typically be graded to a depth of 100 to 150 mm for either a blade-width over the trench line, or the entire non-working side or the full right-of-way, depending on factors such as the soil type, terrain, construction requirements and weather conditions.

In areas where a gibber (rock) mantle is present, consideration will be given to rolling sections of the right-of-way in preference to grading, to maintain the protective gibber cover. However, previous experience during construction of the adjacent Santos line has indicated that grading gibber off the right-of-way during construction and replacing it during restoration is also a suitable method. It also results in a stable restored easement and avoids the issues presented by a rolled gibber easement (e.g. an uneven work surface - particularly for welding, heavy wear to vehicle tyres from gibber and loss of gibber stones in surface soil resulting in difficulties in restoration).

Gibber that is removed will be stockpiled separately from spoil to allow it to be re-spread during restoration.

The pipeline construction easement (or right-of-way) will typically be 25-30 m wide. It is expected that most of the pipeline, except through sand dunes, will be constructed within a 25 m wide right-of-way. This width allows the pipeline to be constructed safely and the topsoil to be conserved for successful restoration.

The construction easement will be reduced in width for limited distances through sensitive areas (e.g. where large trees are present). Generally a reduced easement is only viable for any significant distance if a road or track parallels the easement.


**Plate 2: Clear and grade of a reduced-width right-of-way adjacent to an existing track**

Note: As there is no existing track adjacent to the proposed pipeline, the total width of the cleared right-of-way would be similar to the combined width of the track and the cleared area shown in this photograph.

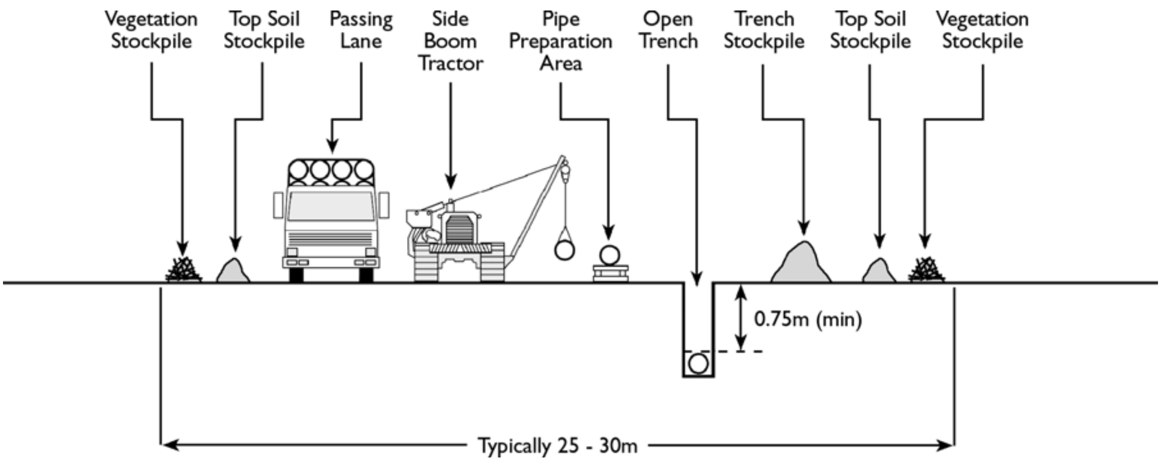



**Figure 2: Typical Right-of-Way Layout for Cross-Country Pipeline Construction**

(Source: APIA 2005)

Where extra working space for construction is required these may be graded or rolled where appropriate (e.g. in gibber areas). Areas outside the construction easement used for extra workspace, turnarounds or laydown areas will be subject to appropriate inspections (e.g. heritage and ecology) and landholder and regulatory sign-off.

Construction through sand dunes will require a width of disturbance in excess of 30 m, as relatively deep excavations are required. Generally, sand dunes are excavated to sufficient depth to achieve 750 mm of cover at the toe of the dune. Due to the limited flexibility of the pipe, this often requires a cut of 4 m depth (or more) to be made through a dune. In areas of steep dunes, the pipeline is often cold-bent on site to allow it to follow the dune profile with less excavation. However, other factors which may prevent limited excavation (such as vehicle access over steep dunes) need to be considered when designing dune crossings.

SEA (1992) provides an example of construction details for a typical 5-6 m high dune where a 4 m cut is required. The width of the cut on the dune crest is estimated to be 35 m (including batters) with a further 20-25 m required for stockpiling of spoil on top of the batter banks and 5 m required for vehicle traffic. Total width of disturbance on a 5-6 m dune at the dune crest is estimated to be in the order of

80-100 m, with the width of disturbance progressively decreasing down the dune. Vegetation would be cleared and stockpiled prior to the cut occurring. This disturbance is relatively temporary and insignificant, and dunes are expected to achieve stable profiles and their vegetation regenerate rapidly following restoration (as evidenced by the dune stability and good regeneration on the Santos pipeline).

Once clear and grade activities commence, the average construction speed is typically in the order of 3 km per day, however there may be delays between one construction activity ceasing and another commencing due to terrain, weather conditions or equipment requirements.

Trenching

After the route is cleared, a trench is dug for the pipeline either by a trenching machine or excavator in accordance with pre-defined depths of burial. The required depths are determined by the AS2885.1 risk assessment process and recorded on construction alignment sheets. Trench distances covered each day can vary from 200 – 4000 m or more dependent on terrain type, equipment and weather conditions. During construction there may typically be 30 km of trench open at any one time however this may vary either side of this number depending upon construction progress.

Trench spoil is stockpiled on the right-of-way, usually on the non-working side. Trench spoil is stockpiled separately to topsoil.


**Plate 3: Trenching**

Blasting

In rocky terrain where the use of conventional excavation, rock hammering or ripping equipment is ineffective, controlled blasting is undertaken.

Where blasting is required, an operational procedure will be prepared detailing the proposed method of blasting, including safety, drill pattern, charges, explosives, detonation and debris control. Blasting will be undertaken in compliance with relevant state legislation and standards by suitably qualified personnel.

Stringing

Steel pipe is trucked to the construction site and sections, each approximately 18 m long, are laid end-to-end next to the trench. The sections are placed on sandbags and raised on blocks of wood (timber skids) to protect the pipe from corrosion and coating damage.


**Plate 4: Unloading and stringing pipe**

Bending

Where required, pipe sections are bent to match changes either in elevation or direction of the route.

Welding, Radiography and Joint Coating

Pipe sections are welded together in lengths up to one kilometre. Each weld is inspected using x-ray or ultrasonic equipment as per AS 2885.2-1995. The area around the weld is wire-brushed or grit blasted and then coated with a protective coating to prevent corrosion.


**Plate 5: Welded pipe string with end caps**

Padding and Shading

In rocky areas it may be necessary to place a layer of rock-free material in the trench to protect the pipe coating from abrasion. This material is generally known as padding (and is also referred to as shading when added after the pipe has been lowered into the trench).

Padding machines are generally used to generate padding by sifting the excavated subsoil to remove coarse materials. The remaining fine material is used to pad beneath and on top of the buried pipe. In some instances (e.g. very rocky soils) imported sand or foam pillows are used for padding.

There are a number of sections of the proposed pipeline route where imported sand may be required because a padding machine may be unable to provide adequate padding. Current estimates are that 20 to 30 km of the route may require some padding. This could amount to approximately 15,000 $m^3$ (based on the conservative assumption that no padding can be generated by the padding machine in these areas), however current expectations are that approximately 3-4,000 $m^3$ will be required.

If required, imported padding for this project may be sourced from existing local excavations with the owners' approval, or it may be obtained by excavating in sandy areas or sand dunes. Extraction from sand dunes would involve removing sand from the side of the dune and then reprofiling the dune. It is unlikely that sand will be excavated from pits. The need for, and location of, sand extraction sites will not be confirmed until detailed design has progressed and further discussions are undertaken with third parties in relation to the use of existing sites. If these extraction sites are within Epic Energy's Pipeline Licence area, they would be operated under the Petroleum Act in accordance with the SEO.

It is anticipated that any new sand extraction sites, if required, would be located within the licence area, at a distance of one to two kilometres from the pipeline. The sites would be within Innamincka Regional Reserve, and would be selected and managed in consultation with DEH. Access to these sites is likely to be along interdune swales and sites would be selected away from public roads, in areas that are not environmentally sensitive. Vegetation clearance would be avoided to the greatest extent practicable. Following excavation, the affected areas would be reprofiled and cleared vegetation respread to encourage regeneration.

Lowering-in and Backfill

Sidebooms (bulldozers with cranes) or excavators are used to lower the welded pipe into the trench and interconnecting sections of pipe are welded. Prior to pipelaying it may be necessary to dewater the trench where rain water or groundwater has accumulated in the trench.

Impermeable trench blocks (otherwise known as trench or sack breakers) may be installed prior to backfilling to control water movement along the backfilled trench. Trench breakers are commonly installed in a number of environmental conditions, such as adjacent to watercourses, on steep slopes or where drainage patterns change.

Trench spoil is then returned to the trench and material compacted to minimise the likelihood of subsidence of material over the pipe.


**Plate 6: Lowering-in**


**Plate 7: Backfill with a grader or excavator**

<u>Pressure Testing</u>

Pipeline integrity is verified using hydrostatic testing in accordance with AS 2885.5. During hydrostatic testing the pipeline is capped with test manifolds, filled with water and pressurised up to 100% of specified minimum yield stress (SMYS) for a minimum of four hours. A 24-hour leak test then follows. Fresh water is preferred for hydrotesting, but hydrotest water may be treated prior to testing with chemicals such as biocide, oxygen scavengers and corrosion inhibitors (depending on factors such as the water quality of test water and the length of pipe tested). If hydrotest water meets water quality guidelines and has landholder approval, it is discharged to the surrounding environment. Alternatively, it may be contained and treated on site or removed off site.

The pipeline is expected to be tested in several sections with water being recycled from one section to the next. Equipment and piping for pumping, testing and water disposal/transfer will be temporarily located at either end of each test section.

Approximately 25,000 $m^3$ of water would be required to fill the entire pipeline, however it is more likely that between 8,000 and 13,000 $m^3$ will be required, to test the pipe in sections. Water for hydrostatic testing would be sourced either from Santos, existing bores or the Cooper Creek if it is flowing, subject to required approvals.

If water cannot be sourced from Santos (e.g. if it is sourced from an existing bore or bores), it may be necessary to construct a temporary, lined holding pond near the bore(s). The pond would serve to hold the water prior to the hydrotest, as the flow rates from the bore(s) may not be adequate to fill the pipeline directly. The pond size has not been determined, but is expected that it would be in the order of 100-200 m x 100-200m. It may be required to hold water for up to a month or more. It is likely that the pond site would be in Innamincka Regional Reserve, and in this case it would be selected and managed in consultation with DEH. Vegetation clearance would be minimised by site selection (it is expected that no trees or long-lived vegetation would be impacted) and the site would be rehabilitated on completion of the testing.

If no biocide is used for hydrotesting the proposed pipeline and the used hydrotest water meets relevant water quality guidelines (e.g. ANZECC criteria), the water may be discharged to land. Where biocide is used, hydrotest water will preferably be discharged to existing evaporation ponds at Moomba or Ballera, subject to operator approval. Alternatively, a new temporary, lined holding pond may be required to allow for the decomposition of the biocide, and other treatment if necessary, to return the water to a quality that may be suitable for land disposal or some beneficial use, such as livestock watering. The water will be tested to ensure compliance with relevant water quality guidelines (e.g. ANZECC livestock watering guidelines) for the receiving environment or beneficial use.

Once the water in the holding pond has been disposed of or allowed to evaporate, the pond liner would be removed and disposed at a licensed landfill and earthworks carried out (as described below) to restore surface profiles and encourage regeneration. The location for a potential holding pond for disposal of hydrotest water has not been determined, however if it were to be required, it may be located near the three-quarter point of the pipeline (near KP 150), on Gidgealpa Station.

Restoration and Rehabilitation

Pipeline construction generates very little waste, and usually includes pipe offcuts, rope spacers and timber skids, which are generally recycled. All waste materials will be removed from the work area and disposed of appropriately.

As soon as practical after pipe laying and backfill, the easement is re-contoured to match surrounding landform and erosion controls constructed where necessary. Separately stockpiled topsoil is then respread evenly across the easement and any cleared vegetation placed across the easement, to assist in soil retention and provision of seed stock.

In some areas (e.g. areas at risk of erosion or densely vegetated creeklines) manual spreading of seed may be carried out to enhance natural regeneration.

Signage

Pipeline information marker signs are erected in line of sight along the easement as per AS 2885.1. Signs are placed at regular intervals so that a marker sign can clearly be seen in both directions. Signs are placed closer together at bends, on either side of a road crossing and at watercourse crossings. Signs are often located on fencelines or on roadsides.


**Plate 8: A newly reinstated easement**

### 3.4.2 Watercourse/Infrastructure Crossings

Watercourse crossings are expected to be constructed using standard open cut (trenching) construction. This technique is most suited to the dry or low flow conditions which are expected during the construction period. If water is present, flow diversion techniques will be employed where necessary.

The standard open cut method involves establishing a stable working platform either side of the watercourse and creating a trench using excavators. The trench will not be completed through the banks until immediately prior to pipe installation. Tie-in points (where the section of pipe used for the water course crossing is connected to the adjacent section of pipeline) are located on high ground well away from the banks.

Watercourse bed and bank material and trench spoil will be stockpiled separately. Pipe string welding and concrete coating will occur prior to placement in the trench. The pipe will be concrete-coated at watercourse crossings and areas of significant inundation (as identified by risk assessment in compliance with AS2885.1) to protect the external coating and reduce buoyancy, preventing the pipe "floating" once in place.

Flow diversion is a modification to the standard open cut method employed where higher water volumes and flows are present (typically up to 1000 litres per second). Flow diversion techniques usually include:

- Diverting the flow through a pipe to prevent siltation problems that may be created during trenching, lowering in and backfilling. This technique is not suitable for watercourses with broad channels, low gradients or permeable substrates.
- Pumping of water around the work area. This is appropriate for low gradient streams, with discharges less than 1000 litres per second during construction. Barrier dykes or head walls are constructed above and below the trenched area and the work area pumped dry.

To minimise the period of construction and subsequent environmental disturbance, Epic Energy aims to complete watercourse crossings within the shortest period practicable (small watercourse crossings would typically be completed within 1-2 days). State agencies responsible for water resources will be consulted prior to construction and during restoration. Appropriate approvals will be in place prior to construction.

Horizontal Directional Drilling

Horizontal directional drilling (HDD) is generally used to cross major watercourses where standard open cut methods are not feasible. It may also be used for road or railway crossings. The feasibility of using HDD is strongly limited by site conditions such as soil stability, slope, access, available workspace and the nature of subsurface rock. It is not expected that HDD will be used to cross any of the watercourses on the proposed pipeline as geotechnical conditions are not suitable, however it has been included in this report as a contingency.

The installation of the pipeline by HDD involves drilling a hole at a shallow angle beneath the surface, then pulling the welded pipe string pipe back through the drill hole (Figure 3). Drilling is conducted by a specially designed drill rig, operated by a specialist contractor. A variety of associated equipment and infrastructure is required (refer to Figure 4). Excavations are typically required for a cuttings settlement pit and drilling mud containment pits at the drill entry and exit points. Depending upon the length of the crossing a HDD can take anywhere between a few days to several weeks to complete.

The size of the HDD rig and its associated footprint depends on the size of the pipe, subsurface geology and the length of the drill. A typical layout for a medium to large HDD rig is shown in Figure 4 (area approximately 40m by 40m). Smaller rigs are often used, particularly for short drills such as road crossings and these are often self-contained (e.g. on the back of a semi-trailer).

Although HDD may reduce above ground impacts, the technique introduces additional environmental considerations such as drill site sediment control, waste management, noise and increased duration of construction and workforce numbers. To address these issues, site specific management procedures are prepared prior to drilling.

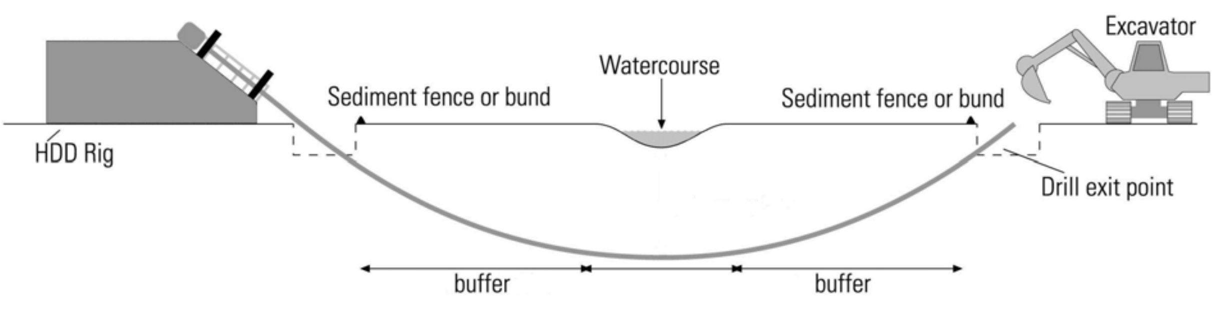
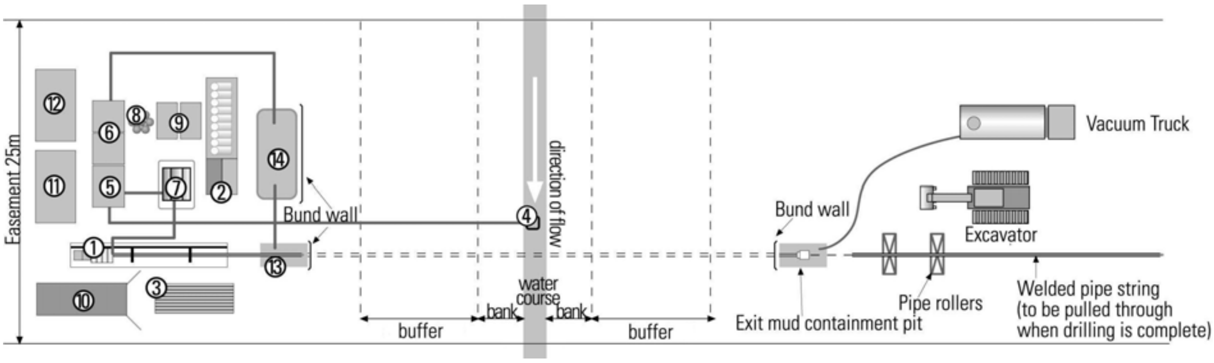



**Figure 3: Schematic Profile of Horizontal Directional Drilling**




1. HDD Rig
2. HDD Control Unit
3. Drill Pipe
4. Water Pump
5. Mud Mixing Tank
6. Cuttings Separation Tank
7. Mud Pump
8. Mud Storage
9. Power Generators
10. Equipment Storage
11. Site Offices
12. Site Offices
13. Drill Entry Point
14. Cuttings (returns) settlement pit

**Figure 4: Plan View Showing Typical HDD layout**

<u>Boring</u>

The technique of boring is commonly used to install pipelines beneath infrastructure such as roads, railways, buried utilities and in some circumstances for watercourse crossings. It is a low impact technique involving drilling short distances from below ground within an enlarged trench area, or bellhole, located inside the construction easement (see Figure 5). Bellholes are required on either side of the road or railway (or watercourse). The bell-hole that accommodates the thrust bore rig is typically 25 m or more long and 4-5 m wide to allow it to hold the rig plus a full length of pipe. The receiving bellhole is typically 4-5 m long and 3 m wide. Depending upon the length of the crossing a bore can take anywhere between 1 to 5 days to complete.

The feasibility of a bore is limited by site conditions, including geology, landform and soil type and depth and width of the watercourse crossing. Boring is not expected to be undertaken for construction of the proposed pipeline.

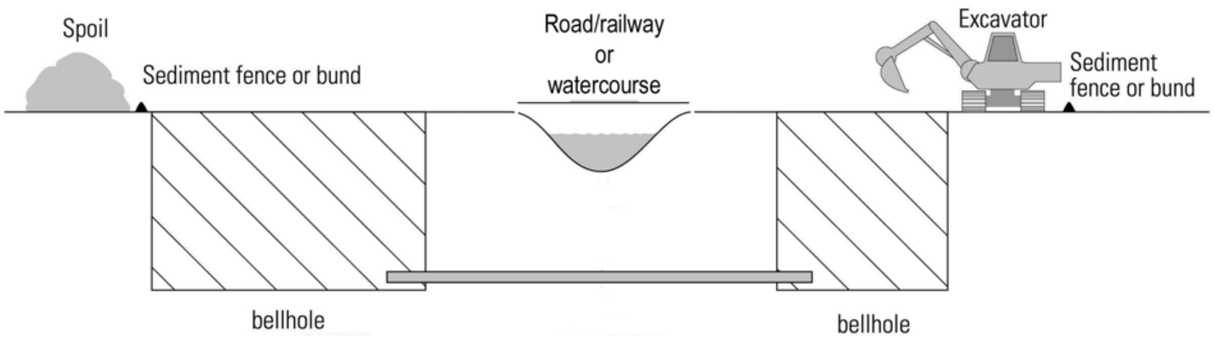



**Figure 5: Schematic Profile of a Bored Crossing**

## 3.5 Operation

Following reinstatement and revegetation of the construction right-of-way, very little above-ground infrastructure will be visible. Above ground infrastructure will be limited to marker posts to identify the location of the pipeline, metering stations, mainline valves and gas delivery stations.

The operation of the pipeline will be in accordance with approval documentation, an Operations Environmental Management Plan (Operations EMP), AS 2885 and the APIA *Code of Environmental Practice – Onshore Pipelines* (APIA 2005).

A summary of pipeline operational activities is provided in Table 5 and discussed below.

A routine operation and maintenance program will be implemented, which will include leak detection surveys, ground and aerial patrols, repair or replacement of faulty pipe or other equipment, pigging and cleaning of the pipeline, corrosion monitoring and remediation and easement and lease area maintenance. Aerial and/or ground inspections will include checking vegetation for discolouration which can be an indicator of a gas leak, detection of erosion, monitoring of rehabilitation success and detection of weed species.

Access to the easement will be necessary to follow-up issues identified from inspections. Low level maintenance for erosion, subsidence and weeds is likely to be necessary, particularly during the first 12 months following construction.

A light vehicle access track may be maintained along the pipeline to allow inspection and maintenance, however existing access tracks will be utilised where possible.

More significant maintenance activities, such as dig-ups to address coating defects, are likely to be infrequently required. However, all maintenance activities that may be required will be conducted in accordance with the SEO and an Operations EMP. Dig-ups involve the excavation of material from around the pipeline (typically referred to as a bellhole), to allow sufficient room for operations technicians to safely undertake any remedial works that may be required. The excavation of material will be undertaken in accordance with management conditions outlined above for construction (that is, topsoil will be stockpiled separately from trench spoil, and the site will be restored as soon as practical following completion of maintenance works).

Prior to commencing extensive work, or where numerous sites are involved, operations personnel will consult with regulatory authorities as appropriate.

Regular consultation will be maintained with landowners whose properties are traversed by the pipeline. The Dial Before You Dig service will be promoted for use by third parties wishing to locate the pipeline prior to undertaking excavations. Operational pipelines generally have very little environmental or landholder impact.

**Table 5: Summary of Pipeline Operational Activities**

| Activity | Description |
|---|---|
| **Easement Maintenance** | |
| Weed Control | Localised spraying of weeds is undertaken along the easement as required. |
| Line-of-sight clearance | Clearance of the right-of-way to maintain line-of-sight is generally not required as it is an arid region with predominantly low open grassland or shrubland.<br>Trees retained on the easement during construction will not be removed, however it may be necessary to remove trees that regenerate within 2 m of the pipeline as they pose a threat to pipeline integrity. |
| Patrolling / inspections - easement access | These are undertaken by travelling along the right-of-way, on private/public roads or over paddocks and will involve access to private property and use of private tracks. Frequency depends on whether particular issue(s) require monitoring; frequency can range from weekly to monthly or longer. |
| Aerial inspection of easement | Inspections are undertaken using low-flying aircraft and typically carried out every 1 to 3 months. |
| **Pipeline Operations** | |
| Cathodic Protection Surveys | Surveys involve travelling the right-of-way and stopping to inspect Cathodic Protection points (above-ground post) on foot. Typically conducted twice per year.<br>Survey may also involve repairs - see “Excavations” below. |
| Testing & Inspection of Relief Valves | Controlled venting of minimal quantities of gas to atmosphere is involved. Typically occurs once per year with a duration of approximately 30 seconds. |
| Erosion events | Following major rainfall events creek lines or run-off areas on right-of-way can experience soil erosion. Repairs are effected immediately following the erosion event and include the replacement of similar materials and re-profiling. |

| Activity | Description |
|---|---|
| Emissions | Methane gas is released to the atmosphere as a result of pipeline and facility maintenance operations (i.e. unit blow downs/ venting, valve opening/testing). Small volumes are released. Occurs for duration of operational life |
| Pipeline Incident | The main threats to public safety from pipeline operation and maintenance are fire, explosion or radiation exposure as a result of pipeline rupture. Pipeline risk assessments have identified that these threats are associated with factors such as third party or external interference to the pipeline and pipeline corrosion. |
| **Pipeline Maintenance** | |
| Pigging | A pipeline 'pig' is placed in the pipe via a launch bay. The pig travels along inside the pipe before being removed at a pig exit site. Removal of a pig from the pipeline results in minor venting of gas to atmosphere and the collection of some oil sludge and debris. Major pigging programs are typically carried out very infrequently (e.g. every 10 to 15 years). |
| Excavations, including coating refurbishment, installation of anode beds, emergency response exercises and new tie-ins | Excavations of the pipeline follow the same processes as those identified Section 3.4.1, namely Clear & Grade, Trenching, Backfill and Restoration & Rehabilitation but are generally on a much smaller scale.<br>Once vegetation and topsoil have been cleared and stockpiled, the excavation is performed and spoil stockpiled. The pipeline maintenance is then undertaken (this may include welding, painting, sand blasting). Once complete the trench is then backfilled, the ground surface is re-contoured and the topsoil and vegetation respread. Some re-seeding may be undertaken if necessary.<br>These activities may occur during the first year of operation to rectify defects, but expected to be very rare during the life of the pipeline. |
| Replacement of pipeline section | A section of the pipeline is isolated and a controlled release of gas is undertaken from the affected section. The affected area is then excavated, the old pipeline removed and replaced (includes welding, blasting, coating) and the site reinstated. This is expected to be very infrequent. |
| Welding | Welding is usually required when pipeline repairs or modifications are made to existing infrastructure. Pipeline welding usually occurs following the excavation of the pipeline. Refer to Section 3.4.1 – Welding, Radiography & Joint Coating. |
| Coating | Sleeves or tape are expected to be used to coat welds or repair areas of pipeline or above ground pipeline. Epoxy painting (spray) may be used.<br>Refer to Section 3.4.1 – Welding, Radiography & Joint Coating. |
| Pressure Testing | Pressure testing is required when a section of pipe is replaced. Pressure testing, even for small sections of pipe, follows the same processes as those identified in Section 3.4.1 – Pressure Testing. |
| **Facility Operation and Maintenance** | |
| Metering and gas delivery stations | Metering stations consist of a valving, metering and gas analysis and scraper launch station. A gas delivery station consists of a station limit valve, scraper receiver, gas filters, gas heaters and pressure regulation. These operate continuously. |
| Weed Control | Localised spraying of weeds is undertaken in and around compounds, typically 1-2 times per year. |
| Production of Hazardous Waste | Waste hydrocarbons are generated from maintenance/ pigging operations (ex pipeline/product).<br>Liquids and heavy metals (e.g. mercury) are not expected in the product, but if present they would be trapped in coalescing filters.<br>Contaminated filters are generated from maintenance change-overs.<br>Contaminated waste and oils will be removed from site for disposal by a licensed contractor. |
| Waste disposal | General waste generated during operations is collected on site and removed to licensed facilities for disposal. |
| Station blow downs | Uncontrolled venting which is a result of equipment failure e.g. regulator failure. Duration would depend on type and duration of failure. |

## 3.6 Decommissioning

When the utility is no longer required, the pipeline will be decommissioned in accordance with the regulatory requirements and accepted environmental best practices of the day. Currently decommissioning procedures require the removal of all above ground infrastructure and the restoration of associated disturbed areas.

At the time of decommissioning a decision will be made regarding the opportunities for future use of the pipeline. If no longer required, the pipeline will be purged of gas and below ground facilities allowed to gradually degrade in-situ. However, if it is considered that the pipeline may offer some future benefits, it will be filled with an inert material and the cathodic protection system maintained to prevent corrosion. All above ground facilities will be removed in any event.

# 4 Project Rationale and Alternatives

## 4.1 Rationale

The QSN Link will join Epic Energy's South West Queensland Pipeline (SWQP) and Epic Energy's Moomba to Adelaide Pipeline (MAP) and provide a delivery point onto the Moomba to Sydney Pipeline (MSP).

The construction of the QSN Link will complete the final link in an interconnected eastern Australian pipeline network and deliver competitively priced gas from Queensland's coal seam methane fields into the wholesale gas hub at Moomba. This will:

- introduce new competitive sources of gas into New South Wales, South Australia and Mt Isa gas markets
- enhance the competitiveness of east coast energy markets by driving basin-on-basin and pipeline-on-pipeline gas competition
- increase the security of gas supply into all the eastern states by providing a gas supply that is independent of the Moomba gas processing plant
- support the continued viability of the MAP and MSP as Cooper Basin gas reserves decline
- provide the opportunity for future gas powered developments, gas-fired power generation growth and displacement of more greenhouse-intensive fossil fuels by clean and efficient natural gas.

## 4.2 Project Alternatives

There are a range of potential alternatives to the proposed pipeline and choice between the various options occurs at a number of levels. For example there are choices to be made between:

- developing the project or not developing the project
- use of the existing Ballera to Moomba gas/condensate pipeline
- pipeline route options from Ballera to Moomba
- project design, construction techniques and environmental impact mitigation measures.

### 4.2.1 The "No Project" Alternative

If the project was not to proceed, the expected benefits would not be achieved. Without the QSN Link:

- increased competition in the gas supply market would not be achieved
- security of gas supply would not be enhanced in the eastern states
- the viability of the MAP and MSP would decrease as Cooper Basin gas reserves decline
- increased demand for energy, particularly for gas generated electricity, is not likely to be met
- new markets for Queensland coal seam methane would not be reached
- the direct economic benefit from construction expenditure and the longer term benefits from the pipeline operation would be lost.

### 4.2.2 Use of Existing Pipeline

Epic Energy has considered an option that utilises the gas production facilities and gas/condensate pipeline between Ballera and Moomba. However, this option requires re-processing of gas at the Moomba gas processing plant and would be affected by any plant problems at Moomba.

In addition, utilisation of the Cooper Basin gas production facilities would limit the potential for third party shippers to utilise the pipeline. Obtaining access to the Cooper Basin gas production facilities for the transportation of gas supplied by independent Bowen/Surat basin gas producers would be very difficult, as gas production facilities are not covered under the Gas Code and hence there is no requirement to provide third party access to facilities.

### 4.2.3 Route Alternatives

The pipeline route has been selected to achieve the most direct route practicable, taking into account a range of technical and environmental factors, including:

- utilisation of existing infrastructure corridors
- minimising impacts to native vegetation (e.g. riparian vegetation, large trees) and culturally significant features
- selecting appropriate, low impact locations for watercourse crossings (particularly the Cooper Creek)
- minimising the number of sand dune crossings
- minimising impacts to landholders and the local community
- minimising impacts to existing infrastructure
- maximising engineering efficiency of both pipeline construction and operation.

Paralleling the existing Santos pipeline is the most logical choice for the pipeline corridor. The existing pipeline follows a direct route from Ballera to Moomba, it is accessible by an existing network of roads and tracks and it was selected with consideration for constructability, engineering efficiency, long-term stability and avoidance of significant environmental impacts.

For these reasons, radically different alternative corridors were not considered. Rather, the pipeline route selection focussed on refining an alignment that generally paralleled the Santos pipeline, taking into account the factors outlined above.

The alignment that has been selected generally follows the existing Santos pipeline, with a typical offset of 50 m to the south of the pipeline centreline, which provides the most acceptable standard offset to suit physical and environmental constraints and minimises the risk to the existing pipeline (particularly where blasting is required).

A number of variations of this 50 m offset from the existing pipeline have been identified, including:

- Between Kilometre Point (KP) 25 and 52 in Queensland, where the existing pipeline traverses a dune field by passing through the lower saddles of the circular dunes and then central between parallel dunes. A parallel pipeline would be constrained to the high ridges of the dunes, many of which are steep and at risk of erosion. In other cases the existing Santos pipeline misses a watercourse with a dune on the other side leaving no room for a new pipeline between. To avoid these issues the QSN Link pipeline will be realigned into the next parallel dune corridor or over the lower saddles of the circular dunes, with the input from the cultural heritage survey, to achieve a constructible route. The expected offset in this area is 200 to 500 m to the south of the existing pipeline.
- At a number of locations where an increased offset of up to typically 100 m or a reduced offset of 20-30 m are required to avoid features such as flow lines, wellheads, watercourses, waterholes and cultural heritage sites.

The alignment will continue to be refined as the outcomes of environmental, cultural heritage, engineering and geotechnical studies are incorporated, and as the detailed design, risk assessment and discussions with landowners progress. No adverse changes to landowner or environmental impacts are expected during this refinement process.

### 4.2.4 Design and Construction Alternatives

The basic design concepts for a high pressure natural gas pipeline are reasonably fixed, and few alternatives exist that would lead to a different level of environmental impact.

At the construction phase however, numerous alternatives exist that may affect the environmental outcome. For example, the option of narrowing the construction right-of-way can be feasible for short sections and can allow impacts to significant features (such as large trees) to be minimised or avoided. Management and mitigation measures for potential impacts of the project are presented in Section 5. Where obvious alternatives exist, these are discussed.

# 5 Impact Assessment

This section provides an overview of the existing environment along the proposed pipeline route, identifies the potential impacts to the environment as a result of pipeline construction and operation and outlines proposed impact mitigation strategies. The implementation of these mitigation strategies will be consistent with the APIA *Code of Environmental Practice – Onshore Pipelines* (APIA 2005) and will be detailed in the Construction Environmental Management Plan.

The information in this section is derived from a variety of sources, including field inspections by RPS Ecos personnel and project team members, specialist surveys of the route, documentation for the existing Santos pipeline (e.g. SEA 1992), unpublished reports relating to the region and petroleum operations, published information and State and Commonwealth government databases.

The description of the environment provided in this section focuses primarily on the current route of the proposed pipeline. However, the environment of the broader area surrounding the current pipeline route is also discussed, to ensure that this EIR covers both the final pipeline alignment and work sites that are not directly on the pipeline right-of-way (e.g. access tracks, camps, materials storage and padding excavation pits). Similarly the Pipeline Licence application is likely to cover a corridor several kilometres wide, to ensure that it contains the final pipeline alignment and these other work sites. However, the pipeline will be constructed within the confines of the construction right-of-way, such that impacts are localised to the right-of-way and above-mentioned sites, and will not affect the entire licence corridor.

## 5.1 Climate

The region has an arid climate, with low average rainfall and high evaporation. Seasons are generally characterised by hot dry summers and mild dry winters. Rainfall in the area is highly erratic, with the annual average being about 150 to 200mm. There is no distinct seasonal rainfall pattern and rainfall is often associated with thunderstorm activity and as a consequence can be intense. For example, a rainfall event of 13mm per hour for one hour can be expected to occur every year (SEA, 1989).

Evaporation is extremely high, with average annual evaporation ranging from 3000 to 3800mm (Queensland Government 1974, Laut *et al.* 1977).

Temperatures vary from cool in winter to hot in summer, with diurnal variations also being high. In summer, the average maximum and minimum temperatures are approximately 38°C and 23°C respectively, and in winter 20°C and 6.0°C. The maximum recorded temperature is 49.1°C and the minimum -1.4°C (BOM 2007).

The most common wind direction throughout the year is from the south-east, with the wind direction becoming more easterly in the north of the project area. Light winds (<20 km/h) are most common from May to July, while the greatest frequencies of strong winds (41-61km/h) occur from September to January.

A summary of climate records for Moomba (Station 017096; BOM 2007) is provided in Table 6.

**Table 6: Temperature and Rainfall Records for Moomba**

| | J | F | M | A | M | J | J | A | S | O | N | D | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Daily Max (°C) | 37.5 | 36.7 | 34.0 | 28.6 | 23.7 | 19.9 | 19.2 | 22.0 | 26.0 | 29.9 | 33.6 | 36.7 | 29.0 |
| Mean Daily Min (°C) | 23.3 | 23.0 | 19.6 | 14.8 | 10.9 | 7.4 | 6.3 | 7.7 | 11.0 | 15.0 | 18.6 | 21.5 | 14.9 |
| Mean Rainfall (mm) | 40.0 | 26.4 | 9.9 | 13.5 | 16.2 | 11.2 | 16.9 | 8.6 | 10.9 | 18.7 | 13.4 | 20.2 | 206.3 |
| Median Rainfall (mm) | 8.9 | 6.8 | 2.2 | 2.1 | 6.2 | 6.0 | 8.3 | 3.8 | 2.3 | 12.9 | 9.7 | 4.6 | 166.4 |

## 5.2 Soils and Terrain

### 5.2.1 Existing Environment

Geology and Landform

The project area overlies sediments which are over four kilometres thick and have been deposited over a period of more than 500 million years. These include the deeper sediments that contain the oil and gas reservoirs of the Cooper Basin and the shallower and widespread sediments of the Eromanga Basin, which form the Great Artesian Basin aquifers that support pastoral activity throughout much of the broader region. The Eromanga Basin sediments are overlain by the Lake Eyre Basin, a succession of Tertiary and Quaternary age sediments that occur extensively throughout central Australia.

Deposition in the Lake Eyre Basin began about 50 million years ago with extensive sand deposits of the Eyre Formation laid down by river systems in a warm and wet monsoonal climate. The silcretes in the Eyre Formation form hard, massive layers which result in the production of tablelands with hard caps. The gibbers that are a common feature of the soil surface in the region are predominantly the pebbles of silica cemented capping that has been left behind as subsequent erosion has slowly worn back these tablelands (Marree SCB, 2004).

The climate became drier about 25 million years ago, and the landscape was dominated by extensive and shallow brackish lakes surrounded by open forest and woodland, which led to the deposition of magnesium-rich limestones, dolomites and siltstones of units such as the Etadunna Formation (Marree SCB, 2004; Krieg *et al.*, 1990).

Much of the current landscape was shaped by geological events over the last million years when a drier climate led to the formation of the present day salt lakes and dune fields. It was during this drier interval that red brown fluvial sands, yellow and red dune sands and saline lake sediments were deposited (Krieg *et al.*, 1990). Dry windy periods about 200,000 years ago commenced the creation of the current dunefields (Marree SCB, 2004).

The resulting landforms traversed by the pipeline route include undulating gibber plain, dunefield, floodplain, river channel and sandplain. Dissected residual tableland, consisting of mesas, buttes and plateaux, occurs in adjoining areas but is not traversed by the pipeline route.

Gibber Plains

The pipeline route traverses areas of undulating gibber plain near Ballera and near the border in Queensland and south-east of Innamincka in South Australia. The silcrete stones that pave the surface of the gibber plains are usually embedded in a thin loamy surface layer, which overlies red to brown clayey subsoils. These clayey subsoils are moderately to strongly saline, easily dispersed and very susceptible to water erosion. The surface layer and subsoils are together known as red-duplex soils.

In their undisturbed state, gibber soils are highly resistant to erosion, as the gibber stones and loamy surface layer protect the unstable sub-soils from rainfall and runoff. When the protective crust and gibbers are removed severe erosion can occur, even on relatively gentle slopes (e.g. 2 to 3 degrees).

Dunefields and Sandplains

The pipeline route traverses the northern edge of the vast dunefields of the Strzelecki Desert. These dunefields consist of generally parallel (but sometimes reticulate) dunes of red to yellow sand, 5 to 10 metres high. Interdune corridors often contain claypans or massive (non-cracking) red sandy clay loams.

The eastern section of the pipeline route (KP[1] 25 to 52) traverses a jumbled system of well vegetated dunes, with small interdune claypans. To the east of this area, from KP 5 to 25, dunes are very sparse and low, and the landform is predominantly a sandplain with massive red sandy clay loam soils.

The pipeline also traverses dunefields further to the west (from KP 116 to Moomba). The dunes in this area are less frequent, parallel and sparsely vegetated. Interdune corridors are wide and characterised by sandy clay loams or pale sandy clays (e.g. in the vicinity of Strzelecki Creek), and for much of this section, individual dunes are separated by broad areas of Cooper Creek floodplain.

River Channels and Floodplains

A large proportion of the pipeline route, particularly in the west, traverses the Cooper floodplain which in places is tens of kilometres wide. The floodplain is characterised by areas of deep grey self-mulching cracking clays and pale sandy clays with a veneer of pale grey sands. A feature of the grey clays is their “crab-hole” like appearance when dry.

The pipeline route traverses the main channel of the Cooper Creek several kilometres east of the Nappa Merrie Homestead, where the floodplain is only several hundred metres wide, and the Strzelecki Creek approximately 10 km south-west of Innamincka. A number of smaller watercourses with narrower channels of sandy or clayey soils are also crossed.

The landforms present along the pipeline route and the approximate length of the pipeline within each landform are shown in Table 7.

**Table 7: Landforms along the proposed pipeline route**

| KP | Description | Gibber | Dunes | Sandplain | Channel | Floodplain |
|---|---|---|---|---|---|---|
| 0-5 | Gibber west of Ballera | ✓ | | | ✓ | |
| 5-25 | Sandplain | | | ✓ | ✓ | |
| 25-52 | Jumbled dunes | | ✓ | | ✓ | |
| 52-66 | Floodplain | | | | ✓ | ✓ |
| 66-86 | Gibber; includes Cooper crossing | ✓ | | | ✓ | |
| 86-101 | Floodplain | | ✓ | | ✓ | ✓ |
| 101-116 | Gibber south-east of Innamincka | ✓ | | | ✓ | |
| 116-180 | Floodplain and dunes | | ✓ | ✓ | ✓ | ✓ |
| *Approximate total length in Qld (km)* | | *27* | *25* | *25* | *0.5* | *11* |
| *Approximate total length in SA (km)* | | *15* | *10* | *25* | *0.5* | *41* |

Soils

The characteristics of the soils traversed by the pipeline route are summarised in Table 8.

[1] Kilometre Point (KP) is the distance in kilometres along the pipeline from the start of the pipeline (i.e. Ballera).

**Table 8: Dominant soil types occurring along the pipeline route**

| | Dunes (Qld) | Dunes (SA) | Sandplain | Floodplain / dune swale | Gibber |
|---|---|---|---|---|---|
| **Description** | Red siliceous sands | Whitish siliceous sands | Red massive earths | Grey self mulching cracking clays | Crusty duplex soils |
| **Symbol** | Uc1.23 | Uc1.21 | Gn2.12 | Ug5.24 | Dr1.32 |
| **Surface Roughness** | None | None | None | None | Stones |
| **Depth** | Deep | Deep | Deep | Deep | Moderately deep |
| **Drainage** | Well drained | Well drained | Well drained | Poorly drained | Well drained |

Source: SEA (1992), Digital Atlas of Australian Soils (Northcote *et al.* (1960-68), BRS (1991)).

**Plate 9: Gibber Plain near Ballera - Qld (KP3)**

**Plate 10: Sandplain – Qld (KP20)**

**Plate 11: Dunefields – Qld (KP32)**

**Plate 12: Alluvial floodplains of the Cooper Creek - Qld (KP52)**

**Plate 13: Cooper Creek – Qld (KP68)**

**Plate 14: Gibber Plains (KP100)**

**Plate 15: Floodplains of the Strzelecki Creek (KP117)**

**Plate 16: Dunefields East of Moomba (KP157)**

### 5.2.2 Potential Impacts

The following activities have the potential to affect the soils and terrain of the project area:

- clear-and-grade operations
- trenching
- backfilling
- reinstatement
- refuelling
- construction access
- extraction of padding material from borrow pits or excavations (if required)
- hydrotest water holding/disposal
- excavations ('dig-ups') undertaken during pipeline operations.

Potential localised impacts to the soils and terrain of the project area include:

- erosion and sedimentation
- soil inversion
- soil compaction
- soil contamination.

Some soils of the project area, particularly the deep sands on dunes, have the potential for trench collapse during construction. In these areas, measures such as benching out or shoring of the trench and bellholes and strict controls on personnel access to the trench will be implemented to address this issue.

Erosion and Sedimentation

Erosion and sedimentation are key potential environmental impacts associated with pipeline construction projects. Pipeline construction primarily consists of earth moving activities, which remove surface cover and disturb soil profiles. Therefore, there is potential for erosion of the construction area and sedimentation of adjacent environments if adequate controls are not implemented, particularly during rainfall events. Inadequate soil compaction over the trench line may also lead to trench subsidence and subsequent erosion.

Stony gibber surfaces are susceptible to gully erosion, particularly on slopes where they are dependent mainly on the gibber cover for erosion protection. The saline clay subsoils are very dispersible, and even gentle slopes can gully if the gibber surface is removed. Minimising gibber disturbance and careful stockpiling and subsequent respreading of gibbers on the construction right-of-way during rehabilitation is required to minimise erosion risk. It is noted that numerous pipelines (such as the adjacent Santos pipeline) have been successfully installed in the region in such soils.

Gully erosion can also occur in almost any country where soils are clay-based and there is some slope. In non-gibber areas, plant cover is the main protection. Minor gullying can occur in dunefields where dune bases have a clay component. Rehabilitation of the easement to encourage plant growth and intallation of control measures (e.g. berms) will minimise this risk.

Gully erosion can also occur in and adjacent to borrow pits if not correctly rehabilitated. Careful battering of borrow pit sides, recontouring of used pits and ripping to facilitate vegetation growth is required to minimise erosion potential.

When rainfall is low, erosion (or aeolian scour) may result from wind action, particularly on sandy soils, where prolonged exposure occurs following initial clearing. However, previous experience in the Cooper Basin has shown that, following construction, dunes tend to readily reform and vegetation re-establishes following reasonable seasons. In addition, a study of deep dune cuts on seismic lines in the Cooper Basin (that were established before 1987 when practices were improved) did not find significant erosion or blow-outs on dunes, and found that dune cuts eventually infill and revegetate so that changes in dune profile and vegetation are virtually undetectable (SEA 1999).

Appropriate drainage controls, topsoil/spoil stockpile management and maintenance of erosion control devices will protect soils and surface water environments from significant erosion and sedimentation impacts. In gibber areas, particular care will be taken to minimise the disturbance of the gibber cover and to reinstate it, as noted in Section 5.2.3.

Soil Inversion

Without effective soil management, topsoil may be “lost” during the construction process by burial beneath (or mixing with) trench spoil during stockpiling, covering with sediment washed in from adjacent areas or returning trench spoil and topsoil to the trench in a sequence different to original profiles.

The loss of topsoil reduces the effectiveness of easement restoration and revegetation by limiting the amount of available nutrients, biomass and productivity and changing the soil’s permeability and water holding capacity. In the case of gibber soils, loss of the protective gibbers increases the risk of soil erosion. However, topsoil is not expected to be “lost” due to the topsoil separation and management measures that will be implemented.

Soil Compaction

Pipeline construction requires compaction of the backfilled trench to prevent the disturbed soil from subsiding. However, vehicle traffic elsewhere on the construction easement can lead to soil compaction, in particular at equipment and machinery laydown areas or areas of heavy vehicle traffic. Soil compaction may change local drainage patterns and prevent effective plant growth. Activities that may cause soil compaction will be restricted to approved areas (e.g. the right-of-way and access tracks) and will be temporary, as it will be rectified during rehabilitation by ripping or scarifying (where appropriate).

Soil Contamination

The potential also exists for construction related activities to result in localised soil contamination. The main potential sources of contamination are:

- minor spills of fuel or chemicals
- discharged hydrotest water.

Pipeline projects involve relatively small quantities of chemicals and likely volumes of spills are extremely low. Pipeline construction equipment (such as graders, bulldozers and side-boom tractors) will be refuelled on the right-of-way from a standard fuel truck. Environmental controls and quality systems will be implemented as discussed below, including erosion and sediment controls and spill prevention and cleanup measures.

Hydrotest water will preferably be fresh but may contain low levels of corrosion inhibiting chemicals or biocides, depending on the water source and total time required for the test. Inappropriate disposal of water of poor quality may result in localised soil contamination and measures to prevent this occurring are detailed below.

However, an investigation of hydrotest water undertaken by the CSIRO (Tjandraatmadja et al. 2005) indicated that for hydrotests where source water is not contaminated and biocides are not added, the quality of the discharge water causes no increase in environmentally hazardous compounds from either the pipe or any treatment added to the water (e.g. oxygen scavengers). The study found that hydrotest water did not have elevated nutrient levels, but did have elevated levels of turbidity, sodium or ammonium sulphate and low levels of dissolved oxygen. The study concluded that current industry treatment methods (to remove solids by sedimentation and/or filtration and to neutralise residual oxygen scavenger and restore dissolved oxygen levels by aeration) are effective in raising the quality of disposal water sufficiently for it to be disposed by irrigation or evaporation or even into watercourses, depending on their characteristics. The study noted that special planning is required when specifying treatment programs for hydrostatic test water containing biocides to deactivate residues prior to discharge to the environment, and when using water that may cause disposal problems (e.g. containing high salinity, presence of sulphate–reducing bacteria, sewage effluent).

### 5.2.3 Impact Mitigation

Mitigation measures will be implemented via the Construction Environmental Management Plan or the Operations Environmental Management Plan to minimise potential impacts. These measures will be based on the APIA *Code of Environmental Practice* and examples of good practice that have been successfully used in the region (e.g. Santos environmental procedures for the Cooper Basin (Santos 2000).

To minimise potential impacts to soil and terrain, the following measures will be implemented:

<u>Erosion and sedimentation</u>

- develop and implement specific management strategies based on soil type and erosion risk, for example:
  - in gibber, minimise gibber disturbance, roll areas rather than clearing where appropriate (e.g. where traffic levels will not be high), carefully stockpile gibber and replace in reinstatement
  - on dunes, stockpile overburden on dune crests and flanks rather than on the interdune flats to allow the approximate pre-construction contours to be readily reinstated
- limit ground disturbance and vegetation clearing to the minimum extent necessary for safe pipeline construction
- during periods of heavy rainfall, suspend all activities likely to result in erosion and sedimentation if their effects cannot be adequately controlled and they may result in pollution of the environment
- install and maintain erosion and sediment control structures in accordance with the Construction Environmental Management Plan (e.g. diversion berms and cross ditches to divert water off the right-of-way to adjacent stable ground)
- limit the period between clear-and-grade and restoration to the minimum practicable
- compact the trench to a level consistent with surrounding soils
- implement appropriate physical and biological stabilisation and site rehabilitation measures in accordance with the Construction Environmental Management Plan
- ensure that windrows or changes in the level between the right-of-way and adjacent land are removed during reinstatement to prevent water channelling along the right-of-way
- leave periodic breaks in any crown left over the trench, to prevent channelling of run-off along the right-of-way
- recontour borrow pits and other excavations used for materials extraction to minimise erosion potential and encourage vegetation regrowth
- after construction is completed:
  - routinely inspect and maintain erosion and sediment control structures, particularly after heavy or prolonged rainfall
  - regularly inspect the easement during operations to identify areas of subsidence
- implement appropriate measures to permanently solve any recurring erosion or subsidence problems.

<u>Soil inversion</u>

- clearly identify the importance of stockpiling topsoil and trench spoil separately, and backfilling the trench in the appropriate soil horizon order in the Construction Environmental Management Plan and environmental inductions
- stockpile topsoil and trench spoil separately
- at the completion of works, respread topsoil across the easement
- regularly inspect the easement to monitor rehabilitation.

<u>Soil compaction</u>

- identify access tracks and turn-around points for vehicles prior to construction
- minimise the number of planned tracks and use existing tracks as far as practicable
- restrict all vehicles and equipment movements to the construction easement or designated access tracks and roads

- rip or scarify compacted areas where necessary to facilitate vegetation growth, with consideration of the soil type and Land System (i.e. generally avoid ripping of gibber)
- regularly inspect the easement to monitor rehabilitation.

Soil contamination

- include a spill prevention, response and cleanup procedure in the Construction Environmental Management Plan, including refuelling techniques and chemical storage and handling requirements
- ensure the easement is kept free of consumable rubbish (such as lunch wrappers) and construction generated waste
- regularly inspect machinery for fuel and oil leaks and maintain in good working order
- use drip tray and spill mats for each coupling during refuelling truck operations
- use spill mats and spill containment equipment onsite if diesel pumps are required on the easement
- implement cleanup procedures if a spill occurs
- incorporate procedures for trench dewatering, hydrotest water disposal and management of contaminated water into the Construction Environmental Management Plan. These may include measures to:
    - dispose of water on site after assessment/analysis, provided the water meets ANZECC criteria for the disposal site
    - contain and treat water on site
    - remove water off site
- obtain landholder approval and EPA approval if required for disposal of trench water or hydrotest water outside easement
- after construction is completed:
    - inspect easement to ensure any construction generated rubbish / equipment is removed
    - inspect the easement to ensure that any spills which may have occurred are appropriately remediated.

## 5.3 Water Resources

### 5.3.1 Existing Environment

Surface Water

The Cooper Creek is the dominant surface water feature in the region. The main channel of the Cooper Creek is generally well defined and connects a series of ephemeral swamps and permanent and semi-permanent waterholes. During floods, the main channels overflow and floodwaters spill into the vast floodplain via numerous distributory channels.

During low flows, most water flows through the North West Branch of the Cooper (which is approximately 85 km downstream of the pipeline crossing of the creek) into the Coongie Lakes and Lake Goyder. If flows are large enough to fill these lakes, additional water flows down the main branch of the Cooper towards Lake Hope and, if flows are sufficient, eventually to Lake Eyre. The water in the Cooper Creek is of sufficient quality to support a diverse aquatic ecosystem.

Flow in the Creek is extremely variable. Flow occurs in one or more discrete pulses each year and several months may pass without flow (Puckridge *et al.* 1999). Flows and flood peaks have been recorded at Nappa Merrie in Queensland since 1949, although there are large gaps in the record (NRW, 2007), and at Cullyamurra (or Callamurra) near Innamincka in South Australia since 1973 (DWLBC, 2007).

Based on these records, the mean annual flow in Cooper Creek is in the order of 1.4 million megalitres (ML), with a median annual flow (at Cullyamurra) of 399,100 ML. The highest annual flow was over 14 million megalitres in 1974. Flow can occur in any month, and zero flows have also been recorded in all months of the year. It has been estimated that there is a 98% chance that flow rates will exceed 1m$^3$/s at Innamincka each year (Kotwicki, 1986). There are, on average, three months per year where no flow occurs at Nappa Merrie.

Mean and median monthly flow volumes at Nappa Merrie for the period of record are shown in Table 9.

**Table 9: Monthly Flows of Cooper Creek at Nappa Merrie (in thousands of ML) (NRW, 2007)**

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 64.6 | 388.9 | 324.4 | 288.5 | 91.2 | 61.2 | 35.5 | 16.1 | 9.3 | 3.1 | 12.5 | 8.5 |
| **Median** | 6.3 | 14.5 | 30.6 | 39.5 | 19.9 | 7.7 | 3.0 | 1.01 | 0.45 | 0.004 | 0 | 0 |

During periods of high flow, floodwaters overtop the banks of the Cooper and flow south down the Strzelecki and Ooranie Creeks in South Australia. The Ooranie and Strzelecki Creeks flow when the level at Nappa Merrie reaches 4.6 m and 6.2 m respectively (SEA 1992). The average frequency of these events has been estimated as 1 in 2 to 5 years and 1 in 10 years respectively (SEA 1992, Puckridge *et al.* 1999). Flow in Ooranie Creek terminates in various ephemeral lakes to the south east of Moomba. Strzelecki floodwaters however, flow much further south, terminating in Lakes Blanche, Callabonna, Frome and Gregory.

Local rainfall and run-off can result in flow in ephemeral watercourses in the region. Most of these watercourses drain into either the Cooper or Strzelecki Creeks. There is no flow data available for these watercourses, but it has been estimated that a rainfall of 15 mm over one hour would be required to cause flow, which is expected to occur once per year, based on Intensity-Frequency-Duration curves for rainfall at Innamincka (SEA 1992). Creeks typically flow for six to twelve hours after rainfall has ceased, before contracting to a series of waterholes.

Significant local rainfall events can also result in shallow inundation of floodplains, inter-dune claypans and other areas of poorly drained impermeable soil, which can persist for days to weeks or longer.

The proposed pipeline route crosses the Cooper Creek in Queensland, approximately 20 km upstream from the border with South Australia. The area of the crossing location is shown in Plate 13. The pipeline route also crosses approximately 30 drainage lines and ephemeral watercourses marked on 1:250,000 topographic mapping, including Colicke Creek, Ballera Creek, Chalky Creek, Katawulka Creek, Parenjelly Creek, Barmaroo Creek, Oondacururrah Creek and Sandy Creek in Queensland and Strzelecki Creek in South Australia.

<u>Groundwater</u>

Groundwater of suitable quality for use by stock is obtainable throughout the region from a number of formations, some of which are part of the Great Artesian Basin. The principal deep formations (e.g. the Hutton sandstone) are generally too deep for use and the most commonly used intermediate depth formations are the Wallumbilla and Winton formations (SEA 1992). Shallow (60m) sub-artesian supplies are obtained from the Tertiary and Quaternary sediments throughout the area. No natural artesian springs are known to occur in the region traversed by the proposed pipeline.

The alluvium along some of the major streams is a frequent source of sub-artesian water (Division of Land Utilisation, 1974). In particular, sandy sequences underlying the Cooper Creek provide a shallow aquifer, which provides baseflow to semi-permanent waterholes during extended dry periods. Water quality is good, although availability is inconsistent and reliant on infrequent flood recharge events.

### 5.3.2 Potential Impacts

The following activities have the potential to affect the shallow groundwater and surface water resources within the project area:

- topsoil stripping
- construction of the pipeline trench
- de-watering of the trench to aid construction
- the storage and handling of small quantities of fuel and chemicals (which have the potential to be spilt)
- the presence of the back-filled trench during operation

- water sourcing
- hydrostatic testing
- watercourse crossings.

Potential impacts of pipeline construction on groundwater and surface water resources include:

- alteration to groundwater and surface water flow regimes
- increased sediment load and turbidity
- contamination
- disruption to third party use
- disturbance to groundwater infrastructure.

Due to the nature of pipeline construction activities and operational conditions (particularly the shallow depth of trenching and the low risk of any surface contamination), no impacts to deep aquifers are likely to occur and these are not considered further.

No impacts to surface water or groundwater are expected during operation, following the successful restoration of surface contours and stability.

Alteration to shallow groundwater and surface water flow regimes

Although extensive shallow groundwater is not likely to be intercepted, localised shallow groundwater may be encountered, particularly in the vicinity of larger watercourses if recent flows have occurred. The intersection of shallow groundwater by the open trench (and the common pipeline industry practice of pumping accumulated water from the trench to aid construction) has the potential to create localised disturbance to groundwater. Due to the minor depth of the intrusion (approximately 1–1.5 m) and the short period for which the trench is open (approximately one to three weeks, depending on the location), the resultant impact on groundwater resources is considered to be inconsequential. The need to protect soils from potential erosion is discussed in Section 5.2.2.

Backfilling the trench after the pipeline has been laid aims to adequately compact returned trench spoil consistent with pre-existing conditions. If the backfilled trench is significantly less compacted than the surrounding soils, it may act as a horizontal conduit to water, altering the local hydrology and exposing the pipeline to potential erosion as a result of these flows. Alternatively, if sections of the trench are compacted more than pre-existing conditions, lateral flows of groundwater may be impeded, potentially resulting in accumulation of groundwater up gradient of compacted surfaces. However, this is unlikely to cause significant impacts due to the relatively shallow trenching depths.

Construction activities may result in physical disturbance to defined watercourses and to overland flow. Impacts to surface drainage patterns associated with overland flow away from watercourses are less noticeable. If they occur, impacts are most likely to be associated with the presence of temporary linear stockpiles of topsoil and trench spoil and modifications to surface contours during earthworks, which may impede or change natural overland flows. However, these impacts are not likely to be significant due to their short duration, the limited area that will be affected at any given time and the soil management and rehabilitation practices that will be implemented.

Extraction of water for hydrostatic testing, camp use or other construction use (e.g. road maintenance) has the potential to impact groundwater or surface water flows if not appropriately managed. If extraction of water from the Cooper Creek was required, it would be carried out in accordance with the parameters established (after extensive consultation) in Geodynamics (2003) i.e. water would be pumped only if Cooper Creek is running at Innamincka causeway, at a maximum rate of 16 L/s, over a maximum 3 month period and maximum volume not exceeding 80 ML. Under these conditions, water extraction would not be expected to have any significant impact Cooper Creek flows. Any bore water used would be extracted in accordance with licensing conditions, and would most likely be obtained from existing bores.

Increased sediment load and turbidity

A temporary increase in sediment loads entering streams and possible increased turbidity may occur during construction. The major source of sediment is erosion, transported by surface run-off, stream bank collapse and disposal of turbid trench water. The extent of sedimentation is determined by factors such as soil type, slope, run-off volume and velocity and vegetation cover. Inappropriate siting of watercourse crossings (e.g. on bends or unstable sections in watercourses) can increase the potential for erosion and increased sedimentation.

Implementation of erosion control measures, appropriately designed watercourse crossings and appropriate trench water disposal will avoid significant impact. It is noted that the surface water in the area generally has a high turbidity and is not highly sensitive to turbid runoff.

Contamination of surface water or groundwater

The potential exists for project related activities to result in localised groundwater or surface water contamination. The main potential sources of contamination are:

- minor spills of fuel or chemicals
- discharged hydrotest water.

Pipeline projects involve relatively small quantities of chemicals and the risks to water resources associated with minor spills are extremely low. Pipeline construction equipment (such as graders, bulldozers and side-boom tractors) will be refuelled on the right-of-way from a standard fuel truck. These trucks typically hold up to 16,000 litres, however it is highly unlikely that a storage tank on a fuel truck would be breached and the entire contents be spilt. Fuel and chemical handling and storage measures will be implemented to minimise risk of contamination occurring.

Fresh water is preferred for hydrotesting, but as previously discussed may contain low levels of oxygen scavengers and/or corrosion inhibiting chemicals. Inappropriate disposal of this water (for example directly to a watercourse) may result in localised contamination of water resources, however controls on hydrotest water disposal will ensure that this does not occur.

The operating pipeline does not present a significant contamination risk to surface or groundwater resources (including the Cooper Creek). The gas in the pipeline will comprise mostly methane and has a very low solubility in water. If a leak or rupture were to occur, the gas in the pipeline would form a lighter than air mixture and escape to the atmosphere.

Disruption to third party use

It is recognised that impacts to water resources are not limited to the hydrological issues of water quality and quantity, but may also extend to:

- local ecology (terrestrial and aquatic fauna)
- pastoral water users (stock watering)
- local visual amenity.

These issues are discussed further in Sections 5.4, 5.8 and 5.9.

Disturbance to groundwater infrastructure

The pipeline corridors pass through areas containing pastoral bores. Impacts to such infrastructure (through physical damage during construction) are highly unlikely as the alignment has been selected to avoid such infrastructure.

Watercourse crossings

Watercourse crossing techniques have been discussed in Section 3.4.2, and potential impacts to water resources have been broadly discussed above. A summary of different watercourse crossing techniques to compare potential impacts is presented in Table 10.

All watercourses are expected to be crossed using standard open cut techniques. Horizontal directional drilling was considered for the crossing of the Cooper Creek, but it is not considered to be feasible due to unsuitable geological conditions (surface rock outcrops and floating sub-surface rock). It is noted that several previous pipelines have been constructed across the Cooper Creek using open cut techniques without significant impact, in particular, the adjacent Santos pipeline.

The dry conditions that are likely to occur during construction and the proposed mitigation measures outlined below will ensure that impacts to watercourses are not significant or long-term. Watercourses are expected to be dry and will be promptly reinstated following construction. Installation of the pipeline at the Cooper Creek crossing will be timed to avoid high flow periods and if possible will be carried out when there is no flow. Flow diversion techniques would be employed if necessary if low flows are present, in order to avoid flow disruption or siltation downstream, as outlined in Section 3.4.2.

**Table 10: Summary of Potential Impacts of Different Watercourse Crossing Techniques**

| Technique | Potential Hazard | Potential Impact |
|---|---|---|
| **Open Cut** | Inadequate sedimentation controls | Potentially high sediment release during backfilling if controls are not adequately in place |
| **Horizontal Directional Drilling** | Loss of circulation, collapsed hole, stuck drill stem, lost tools | Failure leads to subsequent attempts and possible additional land requirements |
| | Drill mud seepage directly into land and water course | Prolonged sediment load and deposition |
| | Washout of cavities and collapse of right-of-way | Sink holes on right-of-way and under water course |
| | Deviation of drill alignment | Potential third party damage |
| | General | Large footprint required for drill pad<br>Short-term visual impacts due to presence of equipment<br>Noise impacts due to stationary workforce and continuous operation |
| **Boring** | Collapsed hole, stuck drill stem, lost tools | Failure leads to subsequent attempts and possible additional land requirements |
| | Washout of cavities and collapse of right-of-way | Sink holes on right-of-way and under water course |
| | Bellhole Dewatering | Discharge erosion, contamination |
| | General | Short term visual impacts due to presence of equipment<br>Noise impacts due to stationary workforce and continuous operation |

(*Adapted from Canadian Pipeline Water Crossing Committee, 1999)*

### 5.3.3 Impact Mitigation

Impacts to water resources are expected to be minor and temporary. Sediment and erosion control measures outlined in the APIA *Code of Environmental Practice* (APIA 2005) will be implemented via the Construction Environmental Management Plan to minimise potential impacts. The Construction Environmental Management Plan (CEMP) will include site specific requirements where appropriate.

The following specific measures will be implemented to mitigate potential impacts to water resources:

- compact the trench to a level approximately consistent with surrounding soils
- install trench breakers to prevent longitudinal water flow within the trench on slopes approaching watercourses
- reinstate surface contours as soon as reasonably practicable
- cease clear-and-grade activities approximately 10m from banks of flowing watercourses until construction of the crossing is imminent
- during final alignment selection, select watercourse crossing locations that minimise the potential for erosion of the pipeline easement at the crossing and minimise impacts to the watercourse
- at watercourse crossings:
  - minimise the area of disturbance as far as practicable

    - conduct subsequent grading and trenching immediately prior to pipe laying (that is, after the pipe is welded)
    - stockpile material (e.g. excavated bank material) in bunded areas away from the watercourse banks
    - contain pumps within lined, bunded areas
    - complete watercourse crossings within the shortest period practicable to minimise the period of open trench and subsequent environmental disturbance
    - where possible riparian vegetation is to remain as a buffer until pipe stringing is imminent.
    - avoid watercourse crossing works during periods of flood or heavy rainfall
    - ensure all equipment necessary for the stream crossing is on-site and in good working order prior to commencing work
- if HDD is used for watercourse crossings
    - locate HDD drill entry and exit points away from watercourse banks, sensitive vegetation and any heritage sites
    - monitor mud flow rates in and out of the bore to determine whether seepage or other losses may be occurring
    - monitor drill entry and exit points for potential fracturing out of drilling mud
    - dispose of drilling mud (bentonite) and cuttings as per approval requirements
    - ensure HDD equipment is in good working order
    - reinstate HDD entry and exit sites (revegetation of the easement aims to re-establish local indigenous plant species where possible) in consultation with regulatory authorities
- remain vigilant for expected storm or flood warnings and develop a contingency plan for such events
- during periods of heavy rainfall, suspend all activities likely to result in erosion and sedimentation if their effects cannot be adequately controlled and they may result in pollution of the environment
- ensure adequate erosion and sediment controls are in place (both during construction and as part of reinstatement) to protect water resources:
    - design erosion and sediment control measures that consider site conditions, slope, vegetation cover, proximity to sensitive environments, construction phase and climatic conditions
    - install diversion berms or drains along the top and at intermediate points down the slopes to the watercourse
    - install silt fences as necessary for interim on-site erosion control
    - monitor, maintain and repair erosion and sedimentation controls to ensure they remain effective, particularly after heavy rainfall events and during periods of prolonged rainfall
- ensure watercourses are adequately reinstated to prevent preferential flow onto the right-of-way
- handle and store chemicals in accordance with Material Safety Data Sheet requirements
- store fuels, lubricants and chemicals within containment areas (e.g. lined, bunded areas) in accordance with Australian Standard AS1940
- include a spill prevention, response and cleanup procedure into the CEMP (which will include refuelling techniques and chemical storage and handling requirements)
- ensure spill response and clean up equipment is on-site prior to commencing works
- prohibit vehicle refuelling within 50 m of a watercourse or on a slope leading to a watercourse
- regularly inspect machinery for fuel and oil leaks and maintain in good working order
- obtain hydrotest water from an appropriate source in consultation with relevant landowners and regulatory bodies and in accordance with statutory requirements
- incorporate procedures for trench dewatering and hydrotest water disposal into the CEMP. These may include measures to dispose of water on site after assessment/analysis (provided the water meets ANZECC criteria for the disposal site), contain and treat water on site or remove water off site.

## 5.4 Flora and Fauna

This section provides a review of flora and fauna issues along the proposed route. It is based on information provided in HLA ENSR (2007) which details results and recommendations of a flora and fauna assessment of the proposed pipeline route conducted in August 2007.

The HLA ENSR assessment involved a desktop assessment, based on existing Commonwealth and State databases, botanical and zoological texts, aerial photography and (where available) existing

Department for Environment and Heritage (DEH) Remnant Native Vegetation Mapping; and a five day field investigation during which the pipeline corridor in South Australia was assessed, including the recording of floral and faunal characteristics at 54 fauna sites and 51 flora sites.

It should be noted that the final pipeline route was still being refined at the time of writing this document and there were realignments and route options being considered (mainly in the Queensland portion of the route). Some of these are located at a distance from the alignment traversed during the field assessment, although they are still within the area subject to desktop assessment. Due to the broad, expansive nature of the land systems of the region, the new alignments traverse very similar habitats to those traversed during the field assessment and the potential impacts of minor route realignments are very unlikely to change. However, the final alignment will be inspected prior to the commencement of construction activities to ensure that the assessments and management measures regarding vegetation and threatened species are valid.

### 5.4.1 Existing Environment

#### 5.4.1.1 Flora

The pipeline alignment transects ten vegetation communities (Table 11). These consist of:

- Two riparian woodland communities
- Two Eucalypt woodland communities
- Two shrubland communities
- Four grassland / herbland communities.

None of the vegetation communities identified are listed as Critically Endangered, Endangered, Vulnerable or Of Concern under the Commonwealth *Environment Protection and Biodiversity and Conservation Act 1999 (*EPBC Act) or the DEH Provisional List of Threatened Ecosystems (DEH in progress).

**Table 11: Vegetation Communities Identified on the Pipeline Route**

| Vegetation Community | Estimated area on 30m right-of-way (ha) |
|---|---|
| Low riparian Coolibah (*Eucalyptus coolabah*) woodland | 0.3 |
| Very low open Coolibah woodland on floodplain | 86.8 |
| Low Coolibah woodland over Queensland Bluebush (*Chenopodium auricomum*) and Lignum (*Muehlenbeckia florulenta*) open shrubs on floodplain lake. | 0.9 |
| Chenopod (*Atriplex* and *Chenopodium* spp) and Lignum open shrubland on floodplain | 31.1 |
| Grass/herbland on floodplain | 53.5 |
| Very low open *Acacia* woodland on drainage line through stony (gibber) plain | 0.3 |
| Low open Mitchell Grass (*Astrebla pectinata*) tussock grass/herbland on stony (gibber) plain | 51.0 |
| Very open *Acacia* and *Senna* spp. shrubland over open grasses and herbs on low sand dunes and swales | 21.0 |
| Sandhill Cane Grass (*Zygochloa paradoxa*) ± Spinifex (*Triodia basedowii*) open grassland on sand dunes | 11.1 |
| Grass/herbland on low sand dunes | 18.5 |

Riparian Coolibah woodland occurs in the riparian zone of the Strzelecki Creek crossing. The tree line is discontinuous, with an open canopy and few shrubs. Very low open Acacia riparian woodland occurs in very narrow strips at the crossing of the Strzelecki Creek tributary that runs through stony gibber plains. This vegetation is very sparse and discontinuous with sections devoid of shrubs. These habitats represent significant value in linear vegetated wildlife corridors (although continuity is variable), protection of stream water quality, bank stability and provision of hollow-bearing “habitat” trees.

Very low open Coolibah woodland on floodplains is one of the major components of the proposed alignment, with ten occurrences along the route. The Coolibah trees are less than 5m in height and canopy coverage is 10 % or less. Shrub cover is sparse to non-existent as is the groundcover of herbs, grasses and low chenopods. This vegetation community provides shelter and shade for fauna.

A 300m section of the alignment passes through a Coolibah woodland over Queensland Bluebush and Lignum open shrubs which surround a large floodplain lake at KP 153. This lake represents an important wetland for the area, providing habitat for an array of water birds and a watering point for cattle and other fauna. Extensive use of this watering point by cattle is evident with a high degree of grazing and trampling of the vegetation.

Chenopod and Lignum open shrubland occurs on floodplains at five locations, mostly as part of a mosaic with Coolibah woodland and Grass/herbland on floodplain and low sand dunes. The shrub coverage ranges from 10-35% and the groundcover is composed of low chenopod shrubs (*Sclerolaena* app.) and a variety of grasses and herbs and would provide significant shelter and habitat for fauna.

The low sand dune and swales occurring along the alignment support very open Acacia and Senna shrubland over open grasses and herbs, while Sandhill Cane Grass and Spinifex open grassland are common to the taller dune systems. Whitewood (*Atalaya hemiglauca*) is sometimes present as a taller emergent shrub. These communities assist in the stabilisation of dune systems and provide fauna habitat.

Low open Mitchell Grass tussock grassland and herbland on stony (Gibber) plain occurs in numerous places along the proposed alignment. The conditions at the time of the field survey were dry and, as a result, many of the grasses had died back and the hardier low chenopod shrubs were dominating. It appeared that Button Grass (*Dactyloctenium radulans*) had been quite prominent prior to the grass dieback, which is regarded as an indication of disturbance, most likely from cattle grazing. However, it is likely that the composition of these habitats would alter significantly after periods of good rain. This vegetation community is very expansive and the distributions of the species present are scattered and widespread.

The grassland / herbland growing on floodplains occurs frequently along the proposed alignment and consists of low chenopod shrubs (*Atriplex* spp.), and a diverse array of herbs, such as Sago weed (*Plantago cunninghamii*) and Bogan Flea (*Calotis hispidula*). The grassland / herbland community growing on sand dunes is composed of low chenopod shrubs (*Salsola kali*), grasses (*Aristida* spp.and *Enneapogon* spp.), and herbs such as Wild Stock (*Blennodia pterosperma*), Poached-egg Daisy (*Polycalymma stuartii*) and Fleshy Groundsel (*Othonna gregorii*). The species composition of these communities is seasonally variable.

The conditions at the time of the field survey were dry and many of the ephemeral lakes and watercourses were without water. As a result, few aquatic plants were observed along the proposed alignment. Aquatic plants were recorded at Strzelecki Creek tributary, Strzelecki Creek, a floodplain lake and numerous drainage lines and depressions on floodplains. The plants recorded included *Cyperus* spp. and Nardoo (*Marsilea drummondii*).

Rare or Threatened Flora Species

Review of the BDBSA[2] and DEWR[2] databases for the wider search area indicated that 26 rare or threatened plant species (i.e. species classified as Rare, Vulnerable or Endangered) have ranges that overlap the wider study area. These species are listed in Appendix 3 (Table A3.1). All of these species have suitable habitat on the pipeline route and were specifically targeted during the field assessment. No rare or threatened plant species were observed during the survey. Whilst the occurrence of such flora species cannot be completely ruled out, it is considered that if any are present, they would be in very low numbers.

[2] DEH Biological Database of South Australia (BDBSA) data and Australian Government Department of the Environment and Water Resources (DEWR) on-line database

Weeds

No declared or non-declared environmental weed species were observed during the field survey in South Australia. The non-declared environmental weed Mimosa Bush (*Acacia farnesiana*), and the naturalised exotic species Spiked Malvastrum (*Malvastrum americanum*) and Buffel Grass (*Cenchrus ciliaris*), were observed in low densities scattered along the Queensland section of the proposed alignment. While these species were not observed along the South Australian section of the proposed alignment, there is potential for them to be spread along the easement and over the state border.

#### 5.4.1.2 Fauna

The desktop fauna assessment identified 256 fauna species that may potentially utilise habitat within the wider area. These comprised 8 amphibians, 58 reptiles, 168 birds and 22 mammals.

Twenty-one of these species are listed as rare or threatened, all of which could potentially utilise habitats within the pipeline corridor. These species are listed in Table 12 and further information is provided in Appendix 3 (Table A3.2). Of the 21 species, three are listed under the EPBC Act and all 21 are listed under the *National Parks and Wildlife Act 1972* (NPW Act).

**Table 12: Rare or Threatened Fauna Identified from Database Searches**

| Common Name | Species Name | Conservation Status* | Known Records** |
|---|---|---|---|
| **Birds** | | | |
| Australian Painted Snipe | *Rostratula australis* | V[1]/R[2] | 1 |
| Grey Grasswren (Bulloo) | *Amytornis barbatus barbatus* | V[1]/R[2] | 1 |
| Australian Bustard | *Ardeotis australis* | V[2] | 2 |
| Bush Stone-curlew | *Burhinus grallarius* | V[2] | 2 |
| Brown Quail | *Coturnix ypsilophora* | V[2] | 2 |
| Brolga | *Grus rubicunda* | V[2] | 2 |
| Flock Bronzewing | *Phaps histrionica* | V[2] | 2, 3 |
| Freckled Duck | *Stictonetta naevosa* | V[2] | 2 |
| Australasian Shoveler | *Anas rhynchotis* | R[2] | 2 |
| Red-winged Parrot | *Aprosmictus erythropterus* | R[2] | 2 |
| Intermediate Egret | *Ardea intermedia* | R[2] | 2 |
| Musk Duck | *Biziura lobata* | R[2] | 2 |
| Red-tailed Black-Cockatoo | *Calyptorhynchus banksii* | R[2] | 2 |
| White-browed Treecreeper | *Climacteris affinis* | R[2] | 2 |
| Grey Falcon | *Falco hypoleucos* | R[2] | 2, 3 |
| Black-breasted Buzzard | *Hamirostra melanosternon* | R[2] | 2, 3 |
| Barking Owl | *Ninox connivens* | R[2] | 2 |
| Blue-billed Duck | *Oxyura australis* | R[2] | 2, 3 |
| Glossy Ibis | *Plegadis falcinellus* | R[2] | 2 |
| Great Crested Grebe | *Podiceps cristatus* | R[2] | 2 |
| **Mammals** | | | |
| Dusky Hopping Mouse | *Notomys fuscus* | V[1]/V[2] | 1 |

* Status: [1] Commonwealth (EPBC) listed – EN = Endangered, V = Vulnerable
[2] State (NPW Act) listed – EN = Endangered, V = Vulnerable, R = Rare
** Records: 1 = EPBC Protected Matters Search, 2 = Biological Database of SA, 3 = HLA ENSR field survey.

During the field assessment, 59 fauna species were recorded (1 reptile, 45 birds and 13 mammals). Four rare or threatened species were observed: Black-breasted Buzzard (*Hamirostra melanosternon*); Grey Falcon (*Falco hypoleucos*), Flock Bronzewing (*Phaps histrionica*) and Blue-billed Duck (*Oxyura australis*).

An additional 63 bird species listed under the EPBC Act as Migratory and/or Marine protected species were identified as previously recorded from the study area. These include species listed under the Japan/Australia Migratory Bird Agreement (JAMBA), China/Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention on the Conservation of Migratory Species. Whilst these are not listed as rare or threatened fauna, they are protected under the EPBC Act. Twenty of the 63 species identified from the desktop assessment were recorded during the field assessment.

Eight introduced species have been recorded within the wider area (1 bird and 7 mammals). Six of these species were recorded during the field assessment: Rabbit (*Oryctolagus cuniculus*), House Mouse (*Mus musculus*), Camel (*Camelius dromedarius*), Red Fox (*Vulpes vulpes*), Horse (*Equus caballus*) and Wild Dog/Dingo (*Canis lupus familiaris*/*C. lupus dingo*).

Fauna Habitats

The South Australian section of the proposed alignment falls within the Channel Country (CHC) bioregion (EA 2000). This bioregion is dominated by low hills with forbfields and Mitchell Grass downs and intervening braided river systems of Coolibah woodlands and lignum / saltbush shrublands and it includes small areas of sand plains. The Channel Country is characterised by extensive river systems that have flood events on an irregular basis. These floods cover large areas and provide extensive habitats for bird and mammal reproductive cycles, resulting in "boom" and "bust" sequences (NLWRA 2002).

Seven broad fauna habitat types were identified on the pipeline route, based on the stratification of vegetation communities into habitats and on field habitat assessments. These habitats are listed in Table 13.

**Table 13: Fauna habitats present within the proposed corridor**

| Fauna Habitat | Description |
|---|---|
| Gibber Plain | Treeless plains with a dense surface stone pavement dominated by Barley Mitchell Grass, with range of short grasses and forbs. |
| Riparian Woodland | Creeks and rivers, from small ephemeral or seasonal drainage lines, through to larger creeks including waterholes. Open woodland on drainage lines, dominated by Coolibah |
| Floodplain Coolibah Open Woodland | Coolibah open woodland on alluvial floodplains and braided channels. Trees are generally lower and sparser than in Riparian Woodland. |
| Floodplain Saltbush and Lignum Shrubland | Chenopod and Lignum open shrubland on floodplains. |
| Floodplain Grassland/Herbland | Sparse to open grassland and/or herbland on cracking clay soils of alluvial floodplains and braided channels. |
| Dunefield | Low sand dunes and interdune swales. Orange dunes with Sandhill Canegrass and/or Spinifex hummock grasslands; pale dunes dominated by seasonally variable grasses and herbs. Occasional claypans between dunes with sparse grassland and/or herbland. |
| Watercourses and waterholes | Creeks and rivers, from small ephemeral or seasonal drainage lines, through to larger creeks, including waterholes. |

Two key habitats were identified: Riparian Woodland / Floodplain Coolibah Open Woodland, and the Strzelecki Creek Floodplain. The proposed alignment transects approximately 0.1 km of Riparian Woodlands and 33.5 km of Floodplain Coolibah Open Woodland.

Riparian Woodland is considered to be a key habitat due to its significance in forming wildlife corridors and refugia, the high levels of moisture and nutrients, and the relatively complex vegetation structure compared to surrounding areas. The Strzelecki Creek Floodplain can support abundant fish, frogs and waterbirds during its very infrequent periods of inundation, when large flow pulses in the Cooper Creek or from heavy local runoff result in an explosion of biological productivity. As indicated in Sections 5.4.2 and 5.4.3, the high significance of these habitats justify additional measures to reduce impacts during construction, such as narrowing the clearing width and retaining large hollow-bearing trees where possible.

Significant Wetlands

The proposed alignment traverses one wetland listed on the Directory of Important Wetlands in Australia (Strzelecki Creek Wetland System, SA003) and passes close to the southern boundary of a Ramsar site (Coongie Lakes, SA001). The alignment is generally 5-10 km from the boundary of the Coongie Lakes wetland area, but approaches to approximately 1 km where the route crosses Strzelecki Creek downstream from the wetland area's boundary. As indicated in Section 5.8.1, the Coongie Lakes Ramsar wetland will not be impacted and the Strzelecki Creek wetland system will be dry when the pipeline is constructed and following completion, it is unlikely there will be any impact on its value (when inundated) as waterbird habitat.

### 5.4.2 Potential Impacts

The following activities have the potential to affect the ecological values of the project area:

- creation of construction access
- clear-and-grade operations (creation of the construction right-of-way)
- trenching
- welding
- earthworks associated with creation of associated stockpiles, temporary water holding ponds, laydown or work areas and construction depots, camps or borrow pits.

Appropriate management will be required to prevent a range of impacts to the ecological values of the region. Such impacts include:

- removal of remnant vegetation
- destruction of fauna habitats
- disturbance to movement corridors
- fauna mortality
- impacts to threatened species and communities
- introduction and spread of environmental weeds.

The flora and fauna assessment has found that the pipeline is not likely to have a significant impact on common, regionally significant or rare or threatened flora species, fauna species, Ecological Communities or ecologically sensitive areas (given the successful implementation of the mitigation and rehabilitation measures). With minor refinements for features such as watercourse crossings, the location of the proposed alignment is appropriate from the perspective of minimising potential ecological impacts.

Removal of Remnant Vegetation

Construction of the pipeline will result in clearance of native vegetation on the construction right-of-way and associated work areas. Table 13 (above) indicates the approximate area of disturbance in each of the vegetation communities that are present. A 30 m wide construction right-of-way has been used to calculate the areas of disturbance in Table 13, however it is likely that the standard construction width will be specified as 25 m and it will be reduced further where practicable, (e.g. through riparian vegetation). Following construction, the right-of-way will be rehabilitated and vegetation will be encouraged to regenerate (with the exception of a strip several metres in width above the pipe, where the pipeline is kept free of trees and large shrubs to protect the pipe from potential root damage).

Consequently, the loss of vegetation cover will be largely temporary. The adjacent existing Santos pipeline provides a good example of regeneration, with many vegetation communities having regenerated almost completely since 1992, with the exception of wheel rut disturbance (e.g. sand dunes, sand plains and gibber plains). Wooded environments such as the Coolibah woodlands take longer to regenerate. It is considered that, following decommissioning of the pipeline, impacts associated with clearing for construction and maintenance are reversible within all vegetation communities.

The locations where the pipeline traverses Coolibah woodland will likely require some clearance of mature Coolibah trees and saplings. The clearance of trees will be avoided as far as possible, by alignment selection, retaining trees on the right-of-way and trimming limbs in preference to clearing where possible. The sparse, discontinuous nature of the riparian woodlands and the sparse distribution of Coolibah trees in the low open woodland on floodplains is advantageous from the perspective of minimising tree clearance. This sparse distribution also mitigates some of the potential impacts commonly associated with clearing through riparian woodland, such as disruption of corridor continuity and loss of habitat (provided by hollows, branches, bark and root systems on banks of the watercourse).

The ephemeral floodplain lake at KP 153 with the fringing vegetation of Coolibah woodland and Queensland Bluebush and lignum could be impacted by loss of habitat (provided by hollows, branches and root systems on the edge of the lake). The inundation of the pipeline as the lake contracts and expands does not present a problem as long as interference to hydrological conditions is negligible and access is not impeded. The most important consideration for this community is in minimising tree loss and avoiding habitat trees, wherever possible (which will be achieved during detailed alignment selection).

The clearance of vegetation in low lying floodplains is unlikely to cause significant impacts due to the widespread, scattered distribution of most species and the fact that bare patches occur naturally in these ecological systems. However, a more significant impact on these communities may be caused by a disruption of hydrological flows (e.g. from raised crowns left from backfilling, or subsided soils along the buried pipeline). Similarly, impacts of vegetation clearance in gibber are very low due to its sparse nature, but the potential for erosion needs to be mitigated to avoid secondary impacts on vegetation (see Section 5.2.1). The clearance of vegetation in sand dune communities has the potential to cause loss of habitat, sand dune / plain stability and visual amenity.

In addition to direct clearance of vegetation the presence of borrow pits has the potential to indirectly impact vegetation quality. Following local rainfall, borrow pits may provide a water source that attracts wildlife, stock and feral animals, which may lead to an increase in grazing pressure in an area.

Fires resulting from construction activities such as welding can potentially damage or destroy vegetation and habitat.

Subject to the successful implementation of the mitigation measures outlined in Section 5.4.3, the potential impacts on remnant vegetation communities would be limited to the direct impacts associated with the proposed clearing footprint. These impacts are not considered to be significant, given the extensive areas of vegetation communities present in the wider area and the small proportions of these proposed to be disturbed.

Destruction of Fauna Habitats

Much of the arid-zone fauna is adapted to unpredictable, patchy and frequently disturbed environments, with life histories that enable them to avoid or survive long periods of adverse conditions and respond rapidly to good conditions. This indicates that the fauna is, in general, relatively resilient to disturbance. It also, however, underlines the importance of refugia such as riparian environments, swamps and permanent waterholes, which are critical for non-migratory fauna to persist through droughts and thus act as sources of population expansion during good conditions.

The pipeline construction will require clearing of vegetation, and this generally equates to a loss of potential fauna habitat. In relation to common fauna species, this is unlikely to result in a significant long-term impact, as similar habitats are available in areas adjacent to the proposed alignment and common species would utilise these habitats. However, removal of habitat such as mature vegetation and hollow-bearing trees (and therefore loss of nesting and foraging resources) and disturbance to temporary and permanent wetlands have been highlighted as potential impacts.

Removal of mature vegetation and tree hollows reduces shelter, nesting and feeding resources. Large hollow-bearing trees are especially important in strips of riparian vegetation along watercourses. Minimising the clearance of trees with hollows will be required to ensure that impacts are minimised.

The temporary and permanent wetlands in the region are important habitat for numerous migratory waterbird species, including several rare or threatened species. These wetlands could be impacted by changes in hydrology resulting from pipeline easements and tracks (e.g. by forming a barrier to sheet flows or providing new routes for floodwaters, changing the patterns of wetland inundation). Other issues include disturbance to fringing vegetation and changes in turbidity and sedimentation following construction. Construction will occur in dry conditions, so many direct impacts will not occur, however careful alignment selection and appropriate reinstatement of surface profiles will be required to ensure that other impacts are minimised.

Disturbance to Movement Corridors

The alignment traverses several areas of Riparian Woodland and Floodplain Coolibah Open Woodland habitats fringing watercourses, which have important fauna values as refugia for wildlife during dry periods and for corridors facilitating the movement of migratory and nomadic species. Riparian woodlands also provide important habitat for local species because of their relatively complex vegetation structure and higher abundance of hollow-bearing trees compared to surrounding landscapes.

Clearing of vegetation in these woodlands has the potential to disrupt and fragment these movement corridors and refugia. Once cleared, riparian vegetation can take many years to be restored to its previous condition. However, as noted above, the sparse, discontinuous nature of the riparian woodland communities present along the pipeline means that clearing is not likely to create significant additional fragmentation.

Pipeline easements are generally narrow and are allowed to regenerate. Consequently, the presence of an easement is not generally considered to present a long-term barrier to wildlife movement.

Fauna Mortality

There is potential for direct impact on some fauna species from being unearthed during construction of the pipeline trench, which may result in injury or death. While larger and more mobile fauna such as birds, macropods and larger reptiles are likely to move away from the disturbance resulting from construction, smaller burrowing or crack-dwelling fauna (including frogs, lizards, snakes and small mammals, especially nocturnal species) are likely to remain under the surface and therefore risk being dug up and injured or killed. This impact would occur for a short period of time in any area. Because this would affect a very small area in relation to the available habitats (which are broad and widespread), effects on fauna populations are unlikely to be significant. Significant fauna species vulnerable to being unearthed include the Dusky Hopping-mouse.

The open trench provides a temporary barrier to fauna movement and there is potential for ground-dwelling fauna to fall into the trench and become trapped and exposed to overheating, dehydration, predation and / or drowning. There is also potential for livestock to fall into the trench and become entrapped or injured. The direct impact of trenchfall on small ground-dwelling fauna is temporary, lasting only as long as the trench is open. Even so, levels of mortality may significantly affect population sizes in the medium term in species with highly restricted distributions or those associated with specific key habitat features transected by the alignment. However, no such species were identified within the wider area of the proposed pipeline.

Measures will be taken to minimise fauna mortality due to the open trench or borrow pits, including provision of escape ramps and shelter sites in the trench where appropriate, and the employment of fauna monitors to remove, record and release any animals captured in the trench.

Impact to Threatened Species and Communities

Flora

The flora assessment established that 26 rare or threatened plant species could potentially occur within the pipeline corridor. The field survey did not identify any of these species as being present and indicated that there is very limited potential for the pipeline to have adverse impacts on any rare or threatened species. Nonetheless, the mitigation measures recommended in Section 5.4.3 will further reduce the potential to impact on any listed flora species.

Fauna

Of the 21 rare or threatened species identified, only the Dusky Hopping-mouse (*Notomys fuscus*) is considered likely to be sensitive to potential impacts from the proposed pipeline (see Appendix 3, table A3.2), from unearthing and trenchfall. This threatened native rodent has been recorded recently (post-1990) from dunefield habitat in the Strzelecki Desert near Strzelecki Creek approximately 40 km south of the proposed route, with older records (1970 – 1990) from south of Innamincka near the alignment (Ehmann, 2005; Moseby *et al.*, 1999). Recent studies in the Strzelecki Desert have recorded the species from red, pale orange and white sand dunes dominated by a range of dunefield vegetation types, including severely degraded and overgrazed sites with high numbers of rabbits and house mice, often near floodplain lakes and creeklines (Moseby *et al*. 1999; 2006).

Suitable dunefield habitat for the Dusky Hopping-mouse is present in patches along the proposed alignment between KP 116 (just east of Strzelecki Creek) and KP 182 (Moomba). The wider area around the proposed alignment has been poorly surveyed in general, and the Dusky Hopping-mouse could potentially be present anywhere in this suitable habitat.

It should be noted, however, that large areas of suitable dunefield habitat are present in the area surrounding the proposed alignment, particularly north of the route between KP 145-171, and the alignment mostly avoids transecting this habitat. If the Dusky Hopping-mouse is indeed present within the study corridor, it may be potentially widespread in the wider area, and the proposed alignment will disturb a minimal proportion of the potential habitat within the surrounding area. The most likely impact on the Dusky Hopping-mouse (if present) is through potential mortality of individuals trapped in the open pipeline trench, and extra effort should be given to inspection of trenches in dunefield habitat. Provided this mitigation measure is implemented, no significant impact is expected on this species.

Nineteen of the twenty listed bird species identified are considered nomadic or mobile species which are unlikely to be significantly impacted by the proposed pipeline. The remaining species, the Bulloo subspecies of the Grey Grasswren (*Amytornis barbatus barbatus*) is restricted to the Bulloo floodplain on Qld-NSW border, over 150 km southeast of the proposed alignment, and is therefore unlikely to be present within the corridor.

The Grey Falcon and Black-breasted Buzzard nest in tall trees along watercourses, which should be retained where possible during clearing. The Red-winged Parrot, Red-tailed Black Cockatoo, White-browed Treecreeper and Barking Owl all nest in hollows, and mitigation strategies to reduce impacts on hollow-bearing trees are outlined in Section 5.4.3.

Given the successful implementation of the mitigation and rehabilitation recommendations provided in Section 5.4.3, it is considered that the proposed pipeline would not result in a significant adverse impact on any fauna species, including those listed as rare or threatened under Commonwealth or State legislation.

Threatened Communities

Critically Endangered, Endangered, and Vulnerable ecological communities (as listed under the EPBC Act) and Endangered, Vulnerable and Of Concern ecosystems (as provisionally listed by DEH) are not known or likely to occur within a 10 km buffer of the proposed pipeline easement and therefore are very unlikely to be impacted by the proposed pipeline development.

Spread of Environmental Weeds

Although the pipeline route is dominated by native plants, the potential exists for weeds to be introduced or spread. This can result in degradation of native vegetation and habitats, and can also render land less productive and in some cases have serious health impacts on livestock.

Introduction and spread of weeds can occur through soil disturbance and the movement of weed material or seeds on earthmoving equipment and vehicles. Imported padding material may also introduce weed species, though this is unlikely as sand pits are tested for noxious weeds and the padding is buried at depth in the trench. Other imported material (e.g. stored pipes, used fencing material) may also result in weed introduction if it is not clean before arrival.

Good weed hygiene will be required to ensure that weeds are not introduced or spread along the pipeline.

### 5.4.3 Impact Mitigation

General

- refine the alignment during survey and detailed design to minimise (and where practicable, avoid) established trees (particularly hollow-bearing trees), ephemeral floodplain lakes and waterholes
- conduct additional flora and fauna assessment during the detailed design stage where appropriate (e.g. significant realignments, campsites, sand extraction sites)
- undertake an environmental clearance inspection of the alignment prior to construction to identify and mark any issues requiring specific management (e.g. to identify trees or vegetation to be retained, check for rare or threatened flora and fauna)
- prevent fauna from accessing food scraps through the careful management of waste materials and prevention of direct feeding by pipeline personnel
- integrate site specific management strategies into the Construction Environmental Management Plan.

Remnant Vegetation

- restrict disturbance (including vehicle access) to the right-of-way and designated work areas/access tracks
- clearly delineate boundaries in the field to identify the extent of vegetation clearing
- select locations for work areas outside the right-of-way (including camp sites, lay-down areas, truck turn-arounds and cathodic protection facilities) that require minimal vegetation clearance and avoid tree clearance
- restrict the right-of-way width to the minimum necessary for safe pipeline construction
- reduce the width of the right-of-way in areas of higher ecological significance (e.g. through riparian vegetation at watercourse crossings) where practicable
- retain trees on the right-of-way where possible
- trim branches that overhang the right-of-way rather than remove complete trees, whilst ensuring that safe access is maintained
- flag areas of reduced right-of-way and where trees are to be trimmed or retained
- stockpile cleared vegetation and respread on the right-of-way following reinstatement. Mulching or burning of vegetation will not be carried out
- ensure that access tracks and the reinstated pipeline do not alter hydrological characteristics (e.g. consider installing a low crown over the trench in areas prone to subsidence and ensure that breaks are left in the crown to avoid channelling water flows)
- allow native vegetation to regenerate on the right-of-way, with the exception of trees and large shrubs on the area above the pipe that is required to be kept clear for pipeline protection and maintenance purposes
- rehabilitate borrow pits to encourage revegetation and minimise water holding capacity
- implement fire prevention procedures and maintain fire prevention and control equipment on site for high risk activities
- comply with the South Australian *Native Vegetation Act 1991* to achieve a significant environmental benefit.

Significant Habitats and Movement Corridors

- select crossing locations of least impact at drainage lines and ephemeral floodplain lakes during detailed survey and route refinement
- reduce the right-of-way width through areas containing significant vegetation (e.g. riparian and floodplain Coolibah woodland) to the minimum practicable
- minimise the removal of established trees and riparian vegetation
- avoid clearing hollow-bearing trees wherever possible. Significant trees that can be retained on the right-of-way will be flagged for avoidance
- time construction to avoid periods of inundation in the Strzelecki Creek floodplain
- minimise sediment impacts to downstream habitats at watercourse crossings by implementing erosion and sediment control measures
- complete watercourse crossings and reinstate drainage within the shortest period practicable
- allow native vegetation to regenerate over the right-of-way (except over the pipe) and spread cleared vegetation/ dead timber across the right-of-way to provide fauna habitat and reduce the barrier to fauna movement.

Avoiding Fauna Mortality

- vehicles will travel at safe speeds that minimise environmental risks and vehicle movements at night should be minimised
- construct borrow pits with ramps that allow fauna to escape
- install trench plugs with slopes no greater than 50% at regular intervals to provide ramps for fauna to exit the trench
- minimise the period of time the pipeline trench is open and the length of open trench
- install measures to minimise fauna fatality in the trench and allow fauna to exit the trench (e.g. sawdust filled hessian sacks soaked in water, branches or ramped gangplanks)
- implement appropriate protocols to inspect the trench and monitor construction activities for fauna and retrieve, record and release any trapped fauna. The trench must be checked daily and fauna handling and identification must be carried out by appropriately trained / qualified and experienced personnel.

Threatened Species

- implement measures outlined above to minimise impacts on vegetation, significant habitats and fauna mortality
- ensure trench inspection and fauna retrieval is rigorous in areas of potential Dusky Hopping-mouse habitat
- liaise with DEH regarding permitting requirements for fauna retrieval and opportunities for collaborative research on entrapped fauna.

Spread of Environmental Weeds

- develop weed management procedures, detailing site specific requirements for the following (where appropriate):
  - weed management zones
  - machinery, vehicle and personnel hygiene measures
  - screening of imported material (e.g. padding) for weeds
  - records management
  - monitoring during and following construction
  - post-construction control
- inspect all vehicles and plant to ensure that they are weed free prior to their initial commencement of works, and conduct washdowns where required
- incorporate weed management procedures into the Construction Environmental Management Plan.

## 5.5 Heritage

### 5.5.1 Indigenous Heritage

**Existing Environment**

An indigenous heritage survey and work area clearance of the South Australian portion of the QSN Link corridor was undertaken in August 2007 by an archaeologist and representatives from the Yandruwandha/ Yawarrawarrka Native Title Claimant Group. The entire corridor was examined and given clearance for the proposed developments by those stakeholders present; with the exception of 70 areas that were recommended to be excluded from impact by the pipeline.

The archaeological material found during the clearance consisted predominantly of flaked/ground stone artefacts and occasional charcoal staining from cooking hearths in eroded scald areas in the dunefields of the Strzelecki Desert; with silcrete quarry sites occurring on the gibber slopes and uplands and associated scatters of stone artefacts (Australian Heritage Services 2007).

Exclusion areas located within the proposed pipeline corridor have been mapped and at the time of writing, the pipeline alignment was being modified to avoid these areas as far as possible. Where exclusion areas are unavoidable, further survey work is likely to be undertaken to refine the exclusion areas and the pipeline alignment, in order to minimise or, where possible, avoid impacts to areas or objects of cultural importance.

A GIS search of the Register of Aboriginal Sites and Objects, maintained by the Aboriginal Affairs and Reconciliation Division of the SA Department of the Premier and Cabinet, was also conducted. No legally protected (under the South Australian *Aboriginal Heritage Act 1988*) Aboriginal Sites included on the Register were located in the project area (Australian Heritage Services 2007).

**Potential Impacts**

The proposed earthworks (particularly clear-and-grade operations) associated with pipeline construction have the potential to disturb archaeological material, should it be present. Impacts may include:

- damage to shallow artefact scatters
- damage to subsurface material
- damage to significant vegetation.

It is not considered likely that there will be significant adverse impacts to indigenous cultural heritage. An initial site clearance has been undertaken, and further clearance work will be carried out with the Yandruwandha / Yawarrawarrka Native Title Claimant Group if required, to ensure that the final pipeline alignment does not significantly impact areas or objects of cultural significance.

Provisions under the Commonwealth *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* and the South Australian *Aboriginal Heritage Act 1988* make it an offence to knowingly disturb, deface or damage an archaeological relic without the prior approval of the relevant State regulatory authority.

**Impact Mitigation**

The following measures will be implemented to mitigate potential impacts to indigenous heritage:

- select a final alignment that avoids cultural heritage sites as far as practicable
- undertake further site clearance work with the Yandruwandha / Yawarrawarrka Native Title Claimant Group for any construction areas not cleared in the initial survey, or to refine exclusion areas (if required)
- conduct a formal induction/briefing of pipeline construction personnel, prior to the commencement of construction, to ensure that there is appropriate awareness of the location of heritage sites and the appropriate measures that will be undertaken to ensure their protection
- include indigenous site identification and protection as part of the induction course

- where necessary, install signage, flagging, fencing or erosion control measures to protect any sites detected near the easement which will not be directly affected by construction
- in the event that site earthworks uncover potential indigenous heritage material, the Epic Energy heritage procedure will be implemented including the following actions:
  - halt work at this location and establish a 100 m buffer around the site. Work may continue outside the buffer area.
  - In South Australia the project Archaeologist and the Aboriginal Heritage Branch of the Aboriginal Affairs and Reconciliation Division of the SA Department of the Premier and Cabinet shall be contacted in order to determine what appropriate action should be taken
- in the event that sites are detected on the alignment and cannot be avoided, obtain appropriate authorisation for unavoidable site disturbances necessary to permit the construction of the pipeline

### 5.5.2 Non-indigenous Heritage

**Existing Environment**

Non-indigenous heritage in the region dates back to early exploration of the region in the mid to late 1800's and the expansion of pastoralism. Many of the historical sites in the region are associated with the failed Burke and Wills expedition of 1860-61 (including the Dig Tree and grave sites) and the subsequent settlement of inland South Australia and Queensland and the establishment of transport routes and pastoralism in the region.

Natural historical sites in the region (including the Innamincka, Cooper Creek and Nappa Merrie areas) contain a diverse range of arid landsystems including floodplains, wetlands, lakes, dunefields and plateau country.

A search of the National and State heritage registers has indicated that there are a number of listed sites present in the region. A summary of listed heritage sites (including natural and historic sites) located within or adjacent to the proposed pipeline corridor and their location is provided in Table 14.

**Table 14: Non-Indigenous Heritage Sites within the Project Area**

| Register Source | Site Type | Name | Place ID # / RNE Code | Location |
|---|---|---|---|---|
| **Sites intercepted by the pipeline corridor** | | | | |
| Register of the National Estate (RNE) | Natural | Nappamerry Area | 9189<br>qld: 4/09/170/0001 | **QLD -** intercepted by pipeline route approx. KP 0 – KP88.6 |
| RNE (Indicative place – not formally registered)<br>SA Heritage Register | Historic | Burke and Wills National Heritage Place | 105139<br>sa: 3/00/260/0229 | **SA** – North of the pipeline route but not actually intercepted by the pipeline<br>**QLD** – intercepted by the pipeline route at KP68 to KP70 |
| RNE (Indicative place – not formally registered) | Historic | Strzelecki Creek National Heritage Place | 105141<br>sa: 3/00/260/0230 | **SA** – intercepted by the pipeline route at KP 116.4 to KP121 |
| **Sites in the vicinity of the pipeline corridor** | | | | |
| Register of the National Estate (RNE) | Natural | Cooper Creek Floodplain | 16750<br>sa: 3/00/260/0143 | **SA** - Runs in parallel to the north of the pipeline route but not actually intercepted by the pipeline |
| RNE<br>SA Heritage Register | Natural | Coongie Lake and Adjacent Area | 5926<br>sa: 3/00/260/0023 | **SA** - 65km north-west of Innamincka off the Strzelecki Track |

| Register Source | Site Type | Name | Place ID # / RNE Code | Location |
|---|---|---|---|---|
| RNE<br>SA Heritage Register | Historic | Burke's Memorial | 5933<br>sa: 3/00/260/0169 | **SA** – North of the pipeline route but not actually intercepted by the pipeline |
| SA Heritage Register | Natural | Innamincka/Cooper Creek State Heritage Area | 12836 (AHPI) | **SA**- 1.5 km north of the pipeline. Located within Innamincka Regional Reserve |
| SA Heritage Register | Historic | Australian Inland Mission Nursing Home (former) / Regional Reserve Headquarters | 17632 / 12759 (AHPI) | **SA** - Innamincka |
| SA Heritage Register | Historic | Gray's Tree | 14228 (AHPI) | **SA** - Gidgeala - Kudriemitchie Rd, Kudriemitchie Outstation |
| Queensland Heritage Register | Historic | Burke and Wills Dig Tree | 601073 | **QLD** - Nappa Merrie Station, approximately 5km North of pipeline route (KP80) |

**Potential Impacts**

The following activities have the potential to impact non-indigenous heritage values within close proximity to the pipeline:

- creation of construction access
- clear-and-grade operations
- trenching.

Impacts to historical and natural heritage areas in the region will not be significant. The pipeline route avoids all listed or readily identifiable historical sites such as structures, buildings, monuments and significant trees.

The alignment traverses three large areas that are listed on the Register of the National Estate, although two of these sites are not formally registered. The existing Santos pipeline, other oil and gas infrastructure and numerous roads and tracks cross (or lie within) these areas. The proposed pipeline will not have a significant impact on the heritage values of these areas. These areas are:

- Nappa Merrie Area – an area of approximately 125 km by 90 km (at its widest points) which contains representative examples of diverse range of arid ecosystems and many historic and indigenous sites. The Ballera gas plant and other oil and gas infrastructure lie within this area.
- Burke and Wills National Heritage Place – a corridor 4 km wide and approximately 60 km long, centred on the Cooper Creek, which extends from 20 km east of the border in Queensland to 30 km west of Innamincka. It is of significance for its association with the Burke and Wills expedition and contains a number of historic sites, including the Dig Tree and the places where Burke died, Wills died and King was found alive.
- Strzelecki Creek National Heritage Place – a corridor 4 km wide and approximately 200 km long centred on the Strzelecki Creek, which was an important transport route and the scene of important events in European exploration and settlement.

Items of heritage significance are protected under the South Australian *Heritage Places Act 1993*.

**Impact Mitigation**

To avoid impacts to historical heritage, the following measures will be implemented:

- obtain appropriate authorisation for site disturbances necessary to permit the construction of the pipeline
- include basic instruction for historical heritage site identification and protection in the project induction package.

## 5.6 Noise

### 5.6.1 Existing Environment

The existing noise environment in the region is expected to be typical of sparsely populated pastoral areas, with generally low levels of background noise dominated by natural sources (e.g. wind, animals and insects) although those sections of the pipeline corridor in close proximity to oil and gas production facilities are an exception. Intermittent background noise from diesel power generators is present near Innamincka and inhabited station dwellings.

The region is extremely sparsely populated and there are no residences near the pipeline alignment. The closest residence is the Nappa Merrie homestead in Queensland, which is over 4 km from the pipeline. The only residences in the vicinity of the pipeline in South Australia are at Innamincka, approximately 7 km to the north.

### 5.6.2 Potential Impacts

Construction Noise

Pipeline construction activity will result in a temporary increase in noise levels within the immediate vicinity of the alignment, associated with the operation of vehicles and equipment such as excavators, graders, bulldozers and boring equipment. However, this is expected to be of short duration and intensity. As there are no residences in close proximity to the pipeline, no significant impacts are likely.

Other sources of noise associated with construction of the pipeline may include campsites (generators) and traffic movements.

Blasting

It is possible that in some areas where hard rock is present, blasting will be necessary. The extent of the nuisance caused by such works depends largely upon the volume of blasting required, the depth of drilling, the character of the rock and the blasting techniques employed. Blasting is not expected to occur in proximity to any buildings or structures. Fauna species are not expected to be affected, as other construction noise would have caused them to vacate the area of potential impact.

Operation

The normal operation of the pipeline is silent along the right-of-way and will not generally involve significant noise impact. Some low-level noise will be generated at the metering stations at each end of the pipeline at Ballera and Moomba, however given the industrial location of these sites the noise will be insignificant compared to background noise. Once the pipeline has been constructed and commissioned there should not be any requirement for the movement of large plant or equipment on the pipeline corridor (except in an emergency) and noise levels along the easement will return to pre-existing levels.

In an emergency, high pressure gas venting may occur at valve sites or at the site of a pipeline rupture. The duration of the venting and the volume of gas vented would be dependent upon the nature of the emergency. As there are no residences in close proximity to the pipeline, no significant impacts are likely.

### 5.6.3 Impact Mitigation

To mitigate potential noise impacts, the following measures will be implemented:

- fit and maintain appropriate mufflers on earth-moving equipment and other vehicles on the site
- select appropriate equipment
- if undertaking drilling, use drilling equipment with noise ratings suitable for use on public roads
- locate and design facilities to meet EPA noise criteria.

## 5.7 Air Quality

### 5.7.1 Existing Environment

The air quality in the vicinity of the pipeline route is expected to be typical of a remote rural environment and influenced by a range of activities such as:

- dust from stock and vehicle movements or high winds
- vehicle and equipment exhaust fumes.

Air quality near existing operations (e.g. Moomba and Ballera) is expected to be marginally influenced by emissions from these operations.

### 5.7.2 Potential Impacts

Atmospheric dust will be the main component of air emissions during the construction phase of the project, principally from clearing and grading, trenching, backfill and reinstatement and vehicle movement. The impacts of dust generation will be of short term duration and generally localised as the construction teams work through an area and can be mitigated by the use of water trucks, particularly in high wind conditions and/or near any sensitive areas.

Other minor sources of air emissions include exhaust fumes from earthmoving and transport equipment. However, these sources are likely to be negligible in the context of existing pastoral, petroleum production and transport land uses of the project area. No measurable impact is likely.

Once the proposed pipeline is in its operational phase, the impact on air quality during operations is expected to be negligible. Minor dust generation from light vehicles and activities associated with the maintenance and monitoring of the pipeline will occur. Minor emissions from the pipeline are likely at above-ground facilities during maintenance operations. Remote operation of valves (in the event of damage or programmed maintenance) uses gas pressure to drive valve actuators and will result in the release of small amounts of gas. Minor emissions from scraper stations will occur during loading and removal of the pipe pig, which would normally occur once every five to ten years during intelligent pigging.

Fugitive emissions are extremely low from pipeline operations. The risk of pipeline ruptures or leaks is also extremely low due to the implementation of protection measures and the routine monitoring, inspection and maintenance that will be carried out.

Given the isolated nature of potential emission generation, impacts on air quality associated with the proposed pipeline are expected to be low.

### 5.7.3 Impact Mitigation

To minimise potential impacts, the mitigation measures will include the following:

- use of dust suppression measures (e.g. water trucks) as required during construction
- rehabilitate exposed surfaces as rapidly as practicable
- lay blue stone aggregate (or similar) in the above ground facilities where appropriate to reduce dust
- keep all construction vehicles and equipment well maintained and fitted with appropriate exhaust systems and devices
- limit vehicle speeds along the right-of-way (to reduce dust and fauna fatalities)
- avoid smoke generation by a strict no burning policy.
- implement fire control procedures in welding operations.
- ensure that all complaints are investigated, recommendations actioned and closed out.
- implement a program of regular monitoring, inspection and maintenance during operations to prevent pipeline rupture and reduce the occurrence of minor leaks from pipeline infrastructure.

### 5.7.4 Greenhouse Gas

During pipeline construction greenhouse gases will be emitted by transport (light vehicle and pipeline trucks) and the use of construction machinery and equipment. Greenhouse gases emitted during the pipeline operations would predominantly arise from very small amounts of natural gas (predominantly methane) venting during routine maintenance.

The quantity of greenhouse gases emitted during all these activities is considered to be very small and will not have a significant greenhouse impact.

The natural gas supplied through the QSN Link has the potential to contribute to a minimisation of greenhouse gas emissions, by displacement of more greenhouse intensive fuels (e.g. coal and petroleum products) in industrial heating applications such as process water heating and in electricity generation.

## 5.8 Land Use

### 5.8.1 Existing Environment

The current land uses in the project area include pastoralism, oil and gas production and processing, conservation and tourism.

Pastoralism

Pastoralism, mainly in the form of cattle grazing, began in the region in the late 1800s and has continued despite dramatic seasonal and economic fluctuations. The floodplains surrounding the Cooper Creek (the channel country) in particular provide pasture and reliable water supplies in the form of permanent waterholes. The adjoining gibber plains and dunefields are also utilised for pasture but this use is dependent on the use of bores to supply water and these areas can generally only support stock on an opportunistic basis after rain. Stocking rates in the region are relatively low.

Pastoral operations in the region are certified under Quality Assurance systems such as the Livestock Production Assurance Program or Cattlecare, which places emphasis on minimising the risk of chemical contamination, bruising and hide damage and ensuring effective herd management and improvement. Several properties in the region are certified for organic beef production but at this stage the properties on the pipeline route do not have organic certification.

Pastoral leases intercepted by the pipeline are:

- Nappa Merrie in Queensland (which incorporates the Chastleton pastoral lease)
- Innamincka and Gidgealpa in South Australia.

Land owners on the South Australian section of the pipeline are listed in Table 15.

**Table 15: Land Owners on the South Australian Section of the QSN Link**

| Name | Registered Proprietor/ Lessee | Tenure |
|---|---|---|
| Gidgealpa | DOCE Pty Ltd | Leasehold |
| Innamincka Regional Reserve | Department for Environment and Heritage (Head Lessee)<br>S Kidman & Co Ltd (Pastoral Lessee) | Leasehold |
| Moomba | Executor Trustee Australia Ltd | Freehold |

Oil and Gas Exploration and Production

Oil and gas exploration in the Cooper Basin commenced in 1954 and the Cooper Basin has become a major supplier of oil and gas in Australia since the discovery of gas reserves at Gidgealpa, near Moomba, in 1963.

Significant oil and gas infrastructure in the region includes:

- the Santos operated oil and gas production plants at Ballera and Moomba (located at the commencement and termination points of the QSN Link pipeline)
- satellite production facilities including Della and Dullingari
- Santos Ballera to Moomba pipeline (located adjacent to and north of the QSN Link pipeline)
- Epic Energy's Moomba to Adelaide gas pipeline and the adjacent Santos Moomba to Port Bonython liquids pipeline
- the Moomba to Sydney gas and ethane pipelines.

The pipeline route passes through a number of petroleum production and exploration licence areas. Numerous oil wells and gathering lines are located throughout the region, and drilling of new oil, gas and geothermal wells is ongoing. Santos is also planning to begin construction of the Jackson to Moomba oil pipeline in November 2007.

Conservation

The proposed pipeline traverses the Innamincka Regional Reserve for approximately 55 km. This is a multiple use reserve, with the regional reserve category designed to enable areas to be managed under a conservation framework while permitting the sustainable use of resources (i.e. oil and gas production and grazing). There are a number of sites within the Innamincka Regional Reserve that are listed on the State Heritage Register or Register of the National Estate Section, as discussed in Section 5.5.2.

The wetlands of the Cooper Creek, and the Coongie Lakes in particular, have been recognised as uniquely valuable due to their diverse, and in places unique, biota. The Coongie Lakes are now included in the Coongie Lakes National Park, which was proclaimed in 2005 and is located within Innamincka Regional Reserve. The Coongie Lakes are also listed under the Ramsar Convention as a Wetland of International Significance. The proposed pipeline passes to the south of the Ramsar area.

The pipeline also traverses the Strzelecki Creek wetland system, which is listed in the Directory of Important Wetlands in Australia (Environment Australia 2001). This system is predominantly dry and flows very intermittently from Cooper Creek south to Lake Blanche during large Cooper floods (Strzelecki Creek flows are thought to occur with an average frequency of 1 in 10 years; Puckridge *et al.* 1999). When flooded, it provides significant habitat for large numbers of waterbirds.

Tourism

The Innamincka, Coongie Lakes and Cooper Creek regions in north-eastern South Australia and south-west Queensland have become increasing popular as tourist destinations over the past 30 years. It is estimated that more than 45,000 people now visit the Innamincka region annually (Desert Channels Queensland, 2004). Cullyamurra Waterhole, Coongie Lake, the Dig Tree, Burke's grave and Wills' grave receive the greatest visitation particularly between May and September. Recreational opportunities in the region include outback camping, fishing, bird watching, canoeing, swimming, archaeology and general exploration.

The majority of the tourist traffic in the region is restricted to the Strzelecki Track and 'Adventure Way' roads which are used by tourists as an outback highway between South Australia and Queensland.

The pipeline passes to the south of a number of sites that receive high visitation, including Innamincka (located 7 km north), Cullyamurra Waterhole (8 km north) and the Dig Tree (5 km north).

### 5.8.2 Potential Impacts

Pipeline construction has the potential to temporarily disrupt land use activities as a result of the disturbance of land on the right-of-way and the presence of vehicles and machinery. In particular the following construction activities have the potential to affect land use activities within the project area:

- construction access
- earthworks
- materials transport and storage
- the storage and handling of small quantities of fuel and chemicals
- presence of a pipeline right-of-way.

The potential impacts on land use as a result of pipeline construction activity include:

- introduction, spread or colonisation of weeds
- restriction in stock movement and possible entrapment of stock in trench
- impact to pastoral properties' certification for quality assurance or organic production (e.g. as a result of poorly managed soil contamination)
- wildfire from welding activities
- increased access by tourists to remote areas along the right-of-way
- increase in local traffic numbers and use of roads (see Section 5.9.3).

In general, these issues can be successfully managed to avoid significant impact. Most of the impacts are temporary in nature and cease once the construction phase of the project has been completed and the easement has been rehabilitated. The operation of the gas pipeline will generally not impact existing land use, as the pipeline will be buried and the construction corridor rehabilitated to as near as practicable to the pre-construction state.

Weed levels along the proposed pipeline corridors are generally low, but there is always some potential for the introduction or spread of weeds if not appropriately managed. Weeds of potential concern are discussed in Section 5.4.

Impacts on pastoral activity will be minor. A very small proportion of pasture will be temporarily lost along the right-of-way during construction, but this is considered negligible given the very large size of the pastoral properties on the pipeline corridor. The mitigation measures outlined below will ensure that activities are planned to minimise disruption and that the trench does not present a significant barrier to stock.

Oil, gas and geothermal exploration and production activities will not be significantly impacted. Infrastructure will be avoided and close liaison with operators in the area (particularly Santos) will be carried out to plan pipeline construction activities appropriately. Discussions are underway regarding possible arrangements to use of some of Santos' infrastructure.

The project is not likely to result in any significant loss of wilderness or conservation value in Innamincka Regional Reserve or the broader region, particularly given the existing pastoral and petroleum activities. As discussed in Section 5.4, it is unlikely to have any significant effect on the conservation of flora and fauna. The Coongie Lakes Ramsar wetland will not be impacted and the Strzelecki Creek wetland system will be dry when the pipeline is constructed and following completion, it is unlikely there will be any impact on its value as waterbird habitat when inundated. The use of the right-of-way by tourists as an additional access through Innamincka Regional Reserve is not considered likely, given that an access track will not be maintained and that there are numerous other access tracks in the region.

Impacts to tourism will be insignificant and generally restricted to temporary visual impact at locations where the pipeline crosses roads and tracks (see Section 5.9.2). The pipeline will not be visible from tourist sites, and tourists are unlikely to be aware of the pipeline when driving on the main roads in the region, particularly after vegetation on the right-of-way near road crossings has regenerated.

### 5.8.3 Impact Mitigation

To mitigate potential impacts to land use during the construction and operation of the pipeline, the following measures will be implemented:

- enter into formal easement agreements outlining the legal responsibilities of both Epic Energy and the landowners
- work closely with landholders and managers to minimise conflict with existing land use activities
- ensure breaks in the trench (trench plugs) are left to allow stock access across the trench, particularly near watering points
- implement measures outlined in Section 5.4.3 to monitor the trench for stock and provide ramps/escape routes
- implement procedures for fuel and chemical storage and handling and spill management that prevent stock access to fuel, chemicals or spills (if they occur)
- implement appropriate quarantine measures and weed control and management protocols during construction and operations, in consultation with landholders and relevant management authorities. These will include:
  - washdown of vehicles and machinery before project commencement
  - inspection of imported material (e.g. padding) or extraction sites for weeds
  - implementing hygiene procedures (e.g. washdown) at key locations if required
  - post-construction weed control if required
- rehabilitate the construction right-of-way in consultation with landholders
- implement appropriate erosion and sediment control measures
- develop and implement appropriate traffic management procedures
- install signage at road crossings and disguise entry points as necessary to discourage public access
- ensure fire prevention and response equipment is present on-site for relevant activities (e.g. welding).

## 5.9 Other Issues

### 5.9.1 Socio-economic

The proposed pipeline route is located in the unincorporated (i.e. out of councils) area of South Australia. Jurisdiction for the area falls under the responsibility of the Outback Areas Community Development Trust which provides limited local government-type support.

The major regional industries are pastoralism, oil and gas production and tourism.

The only township in the region of the proposed pipeline is Innamincka, which has a resident population of approximately 18 (Marree SCB, 2004). Innamincka is located 70 km north-east of Moomba and 7 km north of the pipeline route. Moomba, Ballera and the satellite production facilities have accommodation and recreation facilities that house the petroleum industry workforce, which operates on a ‘fly-in, fly-out’ basis.

Potential impacts on the community are likely to be short-term and minimal. The broader community may benefit both directly and indirectly due to local expenditure during construction. While the majority of the construction workforce will be housed in a temporary construction camp there may be some requirement to accommodate a small number of project personnel at Innamincka.

Once the pipeline is operational there will be no significant adverse social impacts.

### 5.9.2 Visual Amenity

Buried pipelines, by their very nature, have a low level of impact on visual amenity. Generally this is restricted to short term disturbances associated with construction earthworks and localised impacts associated with the presence of above ground facilities. There are unlikely to be any significant long term impacts to the visual amenity of the project area.

The majority of the pipeline corridor is considered to have low visual sensitivity as it is removed from general viewing and there are few elevated vantage points where the pipeline would be visible. The pipeline is only likely to be visible at road crossings.

**Potential Impacts**

Potential impacts to visual amenity are generally described as a visual or aesthetic disturbance to landholders, residents and tourists, where the project may be perceived to contrast significantly with existing landscape settings and aesthetic values.

The following project activities have the potential to affect the visual attributes of the project area:

- vegetation clearing and earthworks during construction
- the success of easement reinstatement and rehabilitation works
- the presence of above ground facilities.

The construction of the pipeline will result in minor and short term disturbance to the visual amenity of the local environment. Key issues include the potential to create breaks in vegetation, line-of-sight along the linear easement and the presence of construction vehicles, equipment and stockpiles. As outlined below, all such issues can be avoided or successfully mitigated.

The disturbed appearance of the easement after construction and prior to vegetation regrowth will create local short term reduction in visual amenity in areas accessible to the public. However this is temporary and considered to be of low potential impact. There will be no substantial or significant long-term change to the aesthetic appearance of the natural environs associated with the pipeline route.

Above-ground facilities such as main line valves and marker signs have a more permanent visible presence. Proposed above ground facilities are relatively small in size and appropriate site selection and screening by existing topography and vegetation are expected to result in minimal impact. Pipeline markers, which are designed to be seen, will not result in a significant visual impact.

**Impact Mitigation**

To reduce the effects of the pipeline on visual amenity, the following measures will be implemented:

- utilise existing roads and access tracks
- stockpile material and equipment in areas away from general public view, where practicable
- maintain all working areas in a neat and orderly manner
- minimise dust emissions, and erosion and sedimentation of land and waterways through implementation of the mitigation measures outlined in Sections 5.2.3, 5.3.3 and 5.7.3
- adopt appropriate waste management practices
- restore, reinstate and rehabilitate the easement as soon as practicable following backfill.

### 5.9.3 Third-party Infrastructure

Impacts to third party infrastructure can be mitigated through careful pre-construction planning and appropriate consultation with relevant regulatory authorities, public utility service companies and landholders. With adequate management the following impacts can be prevented:

- disruption or damage to road and other transport infrastructure or networks
- disruption or damage to utility services
- disruption or damage to private third party property.

**Existing Environment**

Transport Networks

Wherever practicable the existing road network and private access tracks will be used to access the proposed easement and associated pipeline construction sites and for moving equipment and personnel.

The proposed pipeline will cross a number of unsealed public roads, station tracks and Santos access roads. Many of these roads and tracks will also be used for access to the pipeline corridor by vehicles associated with pipeline construction activities. It is planned that all roads will be crossed using standard open cut construction techniques.

The main public road crossings on the pipeline easement are listed in Table 16.

**Table 16: Public Road Crossings on the Pipeline Route**

| State | Road Name | Location | KP |
|---|---|---|---|
| QLD | Adventure Way (Cooper Creek Road) | Thargomindah – Innamincka | 4<br>77 |
| | Nappa Merrie Santos Rd | Santos road to Jackson – commences at intersection with Adventure Way near Nappa Merrie | 74 |
| SA | Adventure Way (Qld Border to Innamincka) | Thargomindah – Innamincka | 93 |
| | New Strzelecki Track (Dillons Highway) | Section of track between Innamincka and Moomba-Dullingari Road intersection | 104 |
| | Old Strzelecki Track | Innamincka to Lyndhurst via Cooper Creek floodplain | 113 |

The major roads in the region are the Adventure Way and the Strzelecki Track. These roads are multiple use roads which carry a relatively high traffic volume, being predominantly a mix of heavy vehicles, light industrial/pastoral vehicles and tourist vehicles. The Strzelecki Track has been estimated to carry approximately 31,000 vehicles every year (DTEI 2007). The ‘Adventure Way’ road between Innamincka and Thargomindah is part of the Adventure Way tourist route which is promoted to tourists in Queensland as the outback route between Adelaide and Brisbane.

Oil and Gas Pipelines

The QSN Link pipeline will be located adjacent to the Santos Ballera to Moomba pipeline (Pipeline Licence (PL) 5). The QSN Link will also cross the Moomba to Sydney gas and ethane pipelines (PL 7 and 8) and the proposed Jackson to Moomba Pipeline in the vicinity of the Moomba Production Plant. The pipeline will also cross a number of gathering lines, predominantly in the Moomba Field. A connection from the QSN Link will be also ‘hot-tapped’ into the Moomba to Adelaide Pipeline (PL 1) and the Moomba to Sydney gas pipeline. Buried cables associated with cathodic protection beds are also present in the vicinity of many of these pipelines.

Telecommunications

There are very few telecommunication cables and associated infrastructure in the region due to the low population density and remoteness of the region. The most significant telecommunications cable present is the recently installed optic fibre cable to Moomba that parallels the Moomba to Sydney gas pipelines.

Water Utilities

There are no major water utilities in the region due to the low population density and remoteness of the region. It is however possible that the pipeline easement may cross stock water pipelines at various locations.

Power

A limited number of power lines are present in the vicinity of some petroleum wells and the vicinity of the Moomba and Ballera plants.

### Private Property

A variety of pastoral infrastructure is present on or near the pipeline alignment. Common types include gates, fences, bores, water pipes (polypipe) and stock yards.

## Potential Impacts

### Transport Networks

The following project activities may disrupt or damage transport networks:

- use of roads during construction by extendable semi trailers delivering stockpiles of pipe to worksites
- use of roads by low loaders mobilising construction equipment between worksites
- transporting of construction personnel to worksites
- open cut crossings of unsealed roads
- pipeline surveillance and maintenance activities during operations.

With adequate management the following potential impacts to the transport network can be avoided or adequately managed:

- loss of road integrity
- localised traffic disruptions.

During construction it is estimated that up to 10,000 pipe sections will be delivered to various locations along the easement. Based on this requirement, it has been estimated that approximately 626 deliveries will be required for the pipeline, transported by extendable semi trailers. Impacts of pipe and equipment transportation during the construction period include slow moving traffic on roads and subsequent disturbance to local traffic and motorists.

Heavy vehicle and equipment movement will result in localised damage to the integrity of the road pavement or surface (that is through wear-and-tear) and road maintenance will need to be carried out. It is possible that some tracks will need to be upgraded (e.g. by grading) for construction access, which will be carried out in consultation with land managers.

It is anticipated that there may be some localised traffic disruptions associated with road crossings as standard open cut road-crossings can typically take up to six hours.

Inspection of the easement will be required during pipeline operations. However, it is expected that inspections will be undertaken by four wheel drive vehicles and by aerial inspection. Impacts to roads or traffic conditions are considered negligible.

### Public Utilities and Buried Infrastructure

The proposed pipeline will not result in significant impacts to public utility services and other buried infrastructure. There are very few utilities present, and they will be identified prior to construction and incorporated into construction line lists and appropriately flagged, earthed, protected and avoided during construction. Crossings will be carried out in consultation with infrastructure managers, in accordance with their requirements.

Utility infrastructure can also pose safety risks to personnel during construction, in particular explosion or fire due to rupture of oil or gas lines, or induced current and direct contact with 'live' wires arising from placement and movement of construction equipment and large metal objects in parallel and close proximity to power lines.

### Private Property

Impacts to private property will be necessary as part of the normal construction process, but will occur with the prior knowledge and approval of the landholder. Such impacts include cutting fences and installing temporary gates, and modifications to existing gates or tracks. Damage will be avoided where practicable and made good on project completion if unavoidable.

**Impact Mitigation**

Transport

To reduce the effects of transport network disturbances, the following mitigation measures will be implemented:

- plan equipment and material transport routes and storage areas in consultation with local and state authorities to minimise disruption to residents and industry
- deliver project related equipment during daylight hours, where practicable
- implement a traffic safety management plan
- reinstate open cut roads to the satisfaction of the relevant authorities
- address any damage caused to roads or bridges caused by construction or associated activities (including ongoing maintenance of roads in liaison with Santos & road authorities where appropriate)
- where practicable, use shuttle buses to transport personnel to worksites
- where appropriate, install temporary gates across easements at roads to reduce illegal entry.

Public Utilities

To reduce the effects of disturbances to public utilities, the following measures will be implemented:

- maintain close liaison with Santos and other utility managers to identify existing overhead and buried cables, lines and pipes
- obtain standard clearance for service crossings from utility managers
- incorporate services onto “line lists” (see Section 6.2.10)
- use preventative flagging to mark the location of services and infrastructure
- appropriately earth equipment and pipe at established intervals
- where possible, cross transmission easements at or near 90 degrees and well away from structures.

Private Property

To reduce impacts to private property, the following measures will be implemented:

- maintain close liaison with all affected landholders
- appropriately note agreed impacts or modifications on the line list
- obtain pre-construction agreement on the type and extent of impact to occur
- obtain pre-construction agreement regarding strategies and responsibilities for rectification of, or compensation for, damage.

### 5.9.4 Public Safety and Risk

Pipelines are recognised as a safe and efficient means of transporting natural gas. However, all developments present some level of risk.

A detailed risk assessment will be carried out in accordance with AS 2885.1 and will result in the application of a combination of physical and procedural measures to ensure that the pipeline design, construction, operation and maintenance and management meet appropriate safety standards.

The risk assessment will involve the identification of all credible threats to the pipeline at all locations along its length. A credible threat to the pipeline can be assumed to include any element which can plausibly cause pipeline failure, including threats due to location (including crossing and land use segments) and general threats common to the entire system (for example, corrosion). The location analysis will consider land use related activities (for example pastoral grazing, heavy industrial, recreation) and crossing segments (for example, main roads, utilities and waterways).

All identified threats presenting an unacceptable level of risk will be mitigated through the adoption of the requirements under AS2885.1. Mitigation considers threats due to external interference (deliberate and accidental) as well as threats due to unsatisfactory design, construction, materials and operations. Threats due to natural events such as erosion and lightning are also considered.

The protection methods available are broadly described in Table 17.

**Table 17: Pipeline Protection Safety Measures**

| Methods | Measures | Description |
|---|---|---|
| Physical Measure | Burial | The entire pipeline will be buried at depth in accordance with AS2885.1. |
| | Barrier/Slab | Crash barriers and concrete slabs will be adopted where risks are not sufficiently mitigated (e.g. within railway easements). |
| | Exclusion | Fences will be installed where necessary to limit access by unauthorised personnel. |
| | Wall thickness | Wall thickness is increased where higher levels of risk to pipeline integrity exists or the consequences of rupture is considered unacceptable (e.g. close proximity to major infrastructure). |
| | Barrier to Penetration | Other physical barriers may be used to protect the pipeline such as coating or encasing. |
| Procedural Measure | Liaison – Contractors | Organisations, such as councils or shires, utility or community groups that may present a threat to the pipeline will be contacted. |
| | Marker Signs | Pipeline signs will be posted in accordance with AS 2885.1. |
| | Marker Tape | Buried marker tape will be installed above the pipe in accordance with the risk assessment under AS 2885.1. |
| | Liaison – Landholders | Landowners will be contacted on an ongoing basis throughout project development, construction and operation. |
| | One-call | Pipeline incorporated in a one call network for efficient processing of public inquiries and enabling an effective pipeline reporting mechanism. |
| | Patrolling | Quarterly patrolling of the entire route throughout the life of the pipeline. |

### 5.9.5 Waste Management

Relatively small amounts of domestic and industrial wastes will be generated during the construction and operation of the proposed pipeline. The types of wastes generated as a result of pipeline construction operation and disposal options are detailed in Table 18.

**Table 18: Typical Wastes and Disposal Options**

| Waste Type | Disposal |
|---|---|
| **Construction** | |
| Packaging – ropes, cardboard | Licensed landfill / recycled |
| Used chemicals and oils – e.g. lube oil, spent x-ray film developer chemicals, used tins from solvents, rust proofing agents or primer | Licensed disposal facility |
| Scrap – welding rods | Recycle if practicable |
| Campsite wastes – putrescibles, paper, timber & plastic piping | Reuse or licensed landfill as applicable |
| HDD cuttings | Licensed landfill |
| **Operation** | |
| Filters (non-oily) | Licensed landfill |
| Sludge (pigging) | Licensed landfill |
| Packaging (maintenance) | Recycle if practicable, e.g. timber pallets |

Campsites require the provision of systems for the management of sewage wastes. These must be managed in accordance with the *Public and Environmental Health (Waste Control) Regulations 1995* and the method of disposal for wastewater must comply with the *Standard for the Construction, Installation and Operation of Septic Tank Systems in SA*, or be to the satisfaction of the Department of Health. Packaged sewage treatment units that meet the Standard (e.g. "Envirocycle" or similar) may be utilised where practical and appropriate. Following treatment via an approved system, wastewater may be disposed of on-site (onto land, well away from any place from which it is reasonably likely to enter any waters, and well away from any infrastructure).

Specific mitigation and procedural measures to be adopted for waste management include:

- develop specific waste management strategies for each waste stream prior to the commencement of any waste producing activities, based on the principles of "Reduce, Reuse, Recycle" and appropriate disposal
- inform site personnel of the required waste management procedures and practices during the workforce induction program
- covering of bins to prevent access by fauna and the spread of rubbish by wind
- manage hazardous wastes, such as solvents, rust proofing agents and primer, in accordance with the requirements of relevant legislation and industry standards
- implement appropriate treatment and disposal of sewage wastes in accordance with the *Public and Environmental Health (Waste Control) Regulations 1995.* The method of disposal for wastewater must comply with the *Standard for the Construction, Installation and Operation of Septic Tank Systems in SA*, or be to the satisfaction of the Department of Health.
- dispose of all hydrotest water in accordance with the Construction Environmental Management Plan
- place a high emphasis on housekeeping and cleanliness at the site. All work areas will be maintained in a neat and orderly manner
- collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations
- store and handle chemicals in accordance with Section 5.9.6
- remove all waste material from the worksite on completion of each section of the pipeline.

### 5.9.6 Hazardous Storage, Spill and Emergency Response

A variety of chemicals may be required on-site for the construction of the proposed pipeline. These include fuel, lube oils, solvents, rust proofing agents and primer. Potential impacts include contamination to soils and water resources and other environmentally sensitive values. Such impacts have been detailed in Sections 5.2, 5.3 and 5.4 respectively.

Mitigation measures undertaken to reduce the effects of hazardous substances and spill events to the environment and third parties will include:

- hazardous material will be securely stored and handled to ensure it cannot drain onto the ground or to watercourses or floodplains
- appropriate storage (e.g. bunding as per regulatory guidelines) of all fuels and hazardous materials used on-site
- materials and equipment required to respond to a hazardous spill will be readily available
- development of procedures for emergency response
- appropriate implementation of cleanup/spill response procedures if the event of a spill
- Material Safety Data Sheets will be kept for each chemical used on-site and at a location that is easily accessible 24 hours per day
- all project personnel on will be instructed on prevention, safety and response practices as a component of the environmental induction process.

# 6 Environmental Management

## 6.1 Environmental Objectives

Environmental objectives have been developed for this project based on the information and issues identified in this document. These objectives have been designed to provide a clear guide for the management of environmental issues during the construction of the pipeline. The objectives are provided in the *QSN Link Pipeline Statement of Environmental Objectives* (Epic Energy 2007).

## 6.2 Environmental Management System

Epic Energy is committed to responsible environmental management of all phases of the QSN Link project. All planning, construction and operation activities will be conducted in accordance with Epic Energy's Environmental Policy (Appendix 1).

Epic Energy has in place a detailed Environmental Management System (EMS) which applies to all of Epic Energy's activities. In addition to Epic Energy's existing standards and procedures, a number of project specific documents will be prepared including a Construction Environmental Management Plan and a training, induction and auditing program. Information on these components is provided in the following sections.

### 6.2.1 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) will be developed for the construction phase of the project. This CEMP will be consistent with the APIA *Code of Environmental Practice* (APIA 2005) and will provide guidance on the environmental aspects and management of the environmental impacts associated with the construction phase of the project. It will also provide a summary of legal and community requirements and the responsibilities of all levels of personnel involved with the project.

The CEMP will include the following information:

- Project overview
- Environmental commitment
- Statutory requirements and environmental legislation
- Environmental objectives
- Environmental responsibilities
- Training requirements
- Reporting
- Auditing
- Environmental Work Procedures
- Environmental Line List.

<u>Environmental Work Procedures</u>

Environmental work procedures (EWP) will be contained in the CEMP. They prescribe the technical specifications and procedures for construction with relation to environmental aspects. They are designed to provide information on how specific tasks are to be carried out in a manner that minimises environmental impacts.

<u>Environmental Line List</u>

An Environmental Line List (ELL) will be used to detail site specific environmental management requirements for construction, including the location of specific environmental features (e.g. important vegetation, watercourses, weed management areas, heritage sites) and associated management measures.

The ELL is derived from information collected during surveys and specialist studies of the alignment. It is used by construction personnel to identify special management areas on the alignment as work progresses and can be used to create and update alignment drawings. Requirements to check and comply with the ELL will be included in the EWPs and in the Alignment Sheets.

Associated Documentation

The CEMP will be accompanied by a number of documents which are also used for environmental management. The likely content and function of these documents is discussed below.

**Alignment Sheets** show the pipeline alignment with landholder, engineering and environmental information attached at the relevant location along the pipeline. They are designed to be used in the field by construction supervisors.

The alignment sheets will contain:

- details on engineering requirements, such as the type of pipe, degree of bend and depth of cover
- landholder information
- environmental information, which indicates where specific management for various aspects of the environment must be carried out (e.g. narrow right-of-way, trees to be retained) and enables reference to the Environmental Line List.

**Technical Drawings** include details of standard and specific construction procedures and are designed by engineers based on contractual and technical requirements of building a pipeline. These drawings are distributed to the relevant construction personnel prior to the commencement of construction.

Technical drawings provide a visual interpretation of the engineering specifications, work procedures or work method statements for the project. They include environmental considerations in the technical notes, where appropriate, and may cover a range of design aspects. For example they may provide information on typical construction situations, such as sediment fence installation, or they may address site-specific construction issues such as the open trenching of a specific watercourse.

### 6.2.2 Job Hazard Analysis and Permit to Work

Permit to Work and Job Hazard Analysis are used to identify and control risks to health, safety, the environment and security of gas supply. They will be utilized during the construction and operation of the pipeline.

### 6.2.3 Responsibilities

Environmental management and compliance will be the responsibility of all personnel.

The indicative organisation and responsibilities for personnel overseeing environmental management during construction are detailed in Table 19. The exact nature and title of these roles will be dependent on the contractual structure established for pipeline construction and one or more of these positions may be amalgamated or the responsibilities shared under a modified arrangement.

The overall responsibility for environmental compliance will lie with the holder of the Pipeline Licence (i.e. Epic Energy). Epic Energy will maintain a high level of on-site supervision of construction and the environmental performance of potential contractors will be reviewed as part of construction tender evaluation. The construction contractor(s) and individuals will also be responsible and accountable through their conditions of employment or contract. The training of all personnel involved in the pipeline construction will ensure that each individual is aware of their environmental responsibility.

**Table 19: Roles and Responsibilities for Pipeline Construction**

| Role | Responsibility |
|---|---|
| Epic Energy Executive Management | Licence holders. Hold overall responsibility for project and environmental management. |
| Epic Energy Project Manager | Directly responsible for the management of the project, including all environmental aspects. |
| Epic Energy Construction Manager | Directly responsible for the overseeing and fulfilling of commitments contained in Construction Environmental Management Plan.<br>Assesses compliance with the CEMP through regular inspection. |
| Epic Energy Land Access & Environment Coordinator | Oversees CEMP implementation.<br>Monitors the activities of construction contractors and assesses compliance with the CEMP.<br>Coordinates the monitoring and audit program.<br>Represents the project on environmental matters with stakeholders.<br>May delegate landowner consultation and environmental management to field based personnel. |
| Construction Contractors | Responsible for ensuring that works comply with the contractual agreements, meet regulatory requirements and that all environmental objectives contained in the contracts are attained. |
| Environmental Adviser(s) | External contractors used in the field to provide specialist advice on specific issues on an "as needs" basis. |
| Environmental Auditor(s) | External auditors contracted periodically to audit the project against the Pipeline Licence and the CEMP. |
| Cultural Heritage Monitors | Aboriginal community representatives engaged to identify aboriginal cultural sites in nominated areas during construction and advise on site management of identified cultural sites. |

### 6.2.4 Induction and Training

All personnel involved with the construction and operation of the pipeline will be required to complete environmental induction and training prior to commencing work. The objective of the training will be to provide project personnel with the necessary training to allow them to recognise and effectively manage the environmental aspects of the project.

The environmental training program will involve the discussion of a variety of issues including:

- relevant legislation and legislative requirements
- roles and responsibilities
- environmental issues for the project, including:
  - management of sensitive areas
  - erosion and sediment control
  - protection of water quality
  - vegetation and habitat management
  - weed control
  - heritage management
  - protecting existing utilities and infrastructure
  - traffic and access
  - waste management
  - emergency response
- project documentation (including the CEMP, EWP, ELL and other associated documents)
- incident reporting.

An environmental training register will be maintained to ensure that all personnel are trained prior to access to the project right-of-way. All personnel will complete a training verification test, which will be reviewed and assessed by the trainer prior to signing of the training register.

### 6.2.5 Environmental Inspection

During construction the pipeline route and construction activities will regularly be inspected and reported upon to ensure compliance with the Construction Environmental Management Plan and other environmental requirements. The construction contractor's environmental personnel will also be required to implement and inspect and report on compliance with environmental requirements.

### 6.2.6 Monitoring

Photographic environmental monitoring points will be installed at a number of locations along the pipeline route. Photographs will be taken at each of these sites prior to the commencement of various stages of the construction cycle and after reinstatement, to provide a visual record of the progress of construction and compliance with environmental objectives.

### 6.2.7 Auditing

It is proposed that at least two environmental audits will be undertaken during the construction of the pipeline.

The first audit will be undertaken during the first construction cycle in order to check compliance with the CEMP, the Statement of Environmental Objectives and legislative requirements. This will enable non-conformances to be identified and preventative action implemented to prevent repetition. The audit will include all work areas.

A second audit will be conducted prior to completion of reinstatement and will focus predominantly on the success of reinstatement and rehabilitation activities.

Regular audits will also be undertaken during the operation of the pipeline, with the first likely to be undertaken 12 months after the completion of construction.

### 6.2.8 Records and Reporting

During all phases of the project an appropriate and auditable record system will be maintained. Environmental reporting will be conducted in accordance with licence conditions.

Environmental records will include:

- non-conformance reports
- remedial actions taken following incident reports
- inspection reports
- training and induction attendance
- consultation records and meeting notes
- audit reports
- monitoring results.

Environmental incidents and identified instances of non-compliance will be recorded and reported on a non-conformance report proforma.

### 6.2.9 Preventative and Corrective Action

The purpose of the CEMP is to identify and manage environmental risks and impacts. This will be achieved through the elements described above. If unforeseen events or system failures occur, the CEMP will provide for prompt identification, review and response, to minimise impacts and prevent reoccurrence. Formal reporting and corrective action will include the use of non-conformance reports and corrective action requests.

### 6.2.10 Operations Environmental Management Plan

An Operations Environmental Management Plan (Operations EMP) will be developed for operation of the pipeline. The Operations EMP will provide guidance on the environmental aspects and management of the environmental impacts of the pipeline's operation. It will also provide a summary of legal and community requirements and the responsibilities of all levels of personnel involved with the project.

The Operations EMP will be similar in structure to the CEMP but will focus on the aspects and impacts associated with the daily operation of a gas pipeline.

# 7 Consultation

Effective consultation allows for an exchange of information and provides an opportunity to promote understanding and resolution of competing interests.

Epic Energy will conduct targeted consultation with relevant interested parties during the process of development and approval of this EIR and SEO and during the detailed design, construction and operation phases of the project.

Epic Energy is committed to maintaining effective communication and good relations with all stakeholders

## 7.1 Key Stakeholders

The following stakeholders have been identified as having a direct interest in the construction and operation of the proposed pipeline:

- State regulatory agencies and relevant government departments
- landowners/occupiers (see Section 7.2)
- operators of utilities and infrastructure
- minerals and petroleum tenement holders
- government statutory bodies with roles in the region
- native title claimants and Aboriginal heritage groups.

Stakeholder consultation being carried out for the proposed pipeline is summarised in Table 20. Where stakeholder consultation is planned but had not been undertaken at the time of writing the entry has been left blank. Issues raised by stakeholders have been addressed within this EIR where appropriate.

**Table 20: Stakeholder Consultation (South Australia)**

| Stakeholder Category | Organisation/Agency | Consultation / Issues Raised |
|---|---|---|
| Regulatory Authorities | Department of Primary Industries & Resources (PIRSA) | Ongoing liaison regarding licensing, approvals, environment etc |
| | Environment Protection Authority (EPA) | |
| State Government Departments | Department for Environment & Heritage (DEH) | Innamincka Regional Reserve<br>Flora/fauna database records |
| | Department of Water, Land & Biodiversity Conservation (DWLBC) | |
| | Department of Transport, Energy & Infrastructure (DTEI) | Road crossings and road use |
| | Aboriginal Heritage Branch, Aboriginal Affairs & Reconciliation Division of the SA Department of the Premier and Cabinet | Recorded heritage sites and database search |
| Other State Government Bodies | SA Arid Land Natural Resource Management Board | |
| Commonwealth Government | Department of the Environment & Water Resources (DEWR) | EPBC referral |
| Heritage/Native Title | Yandruwandha/Yawarrawarrka Native Title Claimants | Heritage agreement & survey |
| Utility Operators | Australian Pipeline Trust (APA) | Connection to Moomba-Sydney pipeline |

| **Stakeholder Category** | **Organisation/Agency** | **Consultation / Issues Raised** |
|---|---|---|
| Petroleum, Geothermal and Mining Tenement Holders / Operators | Santos and Cooper Basin JV partners | Connection to Moomba and commercial/technical discussions<br>Road, water and infrastructure use<br>Facility location<br>Land acquisition<br>Santos environmental practices for pipeline construction |
| | Other tenement holders | Provided notice of entry and information brochure. |

## 7.2 Landowners/occupiers

Landowners and occupiers on the pipeline route have been informed of the proposed project via telephone calls, face to face meetings, an information brochure and formal notices of entry for preliminary survey activities. Epic Energy will continue to work closely with landholders as the project progresses.

A list of owners of the land on the pipeline route is provided in Section 5.8 .

## 7.3 Ongoing Consultation

Epic Energy aims to continue to engage stakeholders from the planning stage right through to construction to ensure that all potential concerns are identified and appropriately addressed. Stakeholder correspondence will be registered and documented to ensure that issues are appropriately resolved.

During construction a number of methods shall be employed to ensure that communications with key stakeholders are maintained, including:

- a telephone contact line
- a complaints register and follow-up procedure
- landholder liaison.

# 8 References


APIA (2005). *Code of Environmental Practice – Onshore Pipelines*. Australian Pipeline Industry Association, Canberra.

Australian Heritage Services (2007) *Work Area Clearance of the proposed Ballera to Moomba Interconnecter Project, Moomba to South Australian Queensland border section of gas pipeline alignment; located to the south west and north east of Innamincka, in the Cooper Basin, South Australia*. A Report to the Yandruwandha/Yawarrawarrka Native Title Claimant Group and Epic Energy, Corporate Shared Services Pty Limited. September 2007.

Barker, B., Barker, R., Jessop J. and Vonow, H. (Eds.) (2005). Census of South Australian Vascular Plants. Edition 5.00. State Herbarium of South Australia. Botanic Gardens of Adelaide & State Herbarium. 18 March 2005.

Bean, A.R. (1999). A revision of *Stylidium* sect. Debilia Mildbr., S. sect. Floodia Mildbr. and S. sect Lanata A.R.Bean (Stylidiaceae). *Austrobaileya* 5(3): 438.

BoM (2007). Climate Data Online. Accessed in September 2007 at www.bom.gov.au/climate/averages. Bureau of Meteorology, Australia.

Botanic Gardens Trust (2007). PlantNET - The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (version 2.0). http://plantnet.rbgsyd.nsw.gov.au. 06 August 2007.

BRS (1991). *Digital Atlas of Australian Soils* (ARC/INFO® vector format). Available at http://www.daff.gov.au/brs/data-tools. Bureau of Rural Sciences after Commonwealth Scientific and Industrial Research Organisation.

Canadian Pipeline Water Crossing Committee (1999). *Water Crossings.* Canadian Pipeline Water Crossing Committee.

DEH (in progress). Provisional List of Threatened Ecosystems of South Australia. Unpublished and provisional list. Department for Environment and Heritage, South Australia.

DEH (2007). Electronic Flora of South Australia species Fact Sheets. South Australian Government, Department of Environment and Heritage.

Desert Channels Queensland (2004). *Our Country: Our Community. A Community Information Paper For the Queensland Section of the Lake Eyre Basin*. Prepared By Desert Channels Queensland, October 2004.

DEWR (2007a). *Acacia pickardii* in Species Profile and Threats Database, Department of the Environment and Water Resources, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2007-08-06@14:48:22.

DEWR (2007b). *Vegetation Management – Threshold Regional Ecosystems.* Department of the Environment and Water Resources, Canberra. http://www.nrw.qld.gov.au/vegetation/threshold_res.php. Last updated and accessed 14 September 2007.

DEWR (2007c). Flora of Australia Online - *Acacia tenuissima*. Last updated: Wednesday, 07-Feb-2007 12:03:51 EST.

Division of Land Utilisation, 1974. *Western Arid Region Land Use Study – Part I.* Technical Bulletin No. 12. Department of Primary Industries, Queensland.

DTEI (2007) Department of Transport, Energy & Infrastructure - Traffic Volumes. Accessed in October 2007 at http://www.transport.sa.gov.au/transport_network/facts_figures/traffic_volumes.asp#rural.

DWLBC (2005). *Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the clearance of native vegetation associated with the minerals and petroleum industry.* Prepared for the Native Vegetation Council, September 2005. Department of Water, Land & Biodiversity Conservation.

DWLBC (2007). e-NRIMS Natural Resources Information System – South Australian Surface Water Archive (Station A0030501: Cooper Creek @ Callamurra Water Hole). http://e-nrims.dwlbc.sa.gov.au/swa/index.cfm (Accessed 11 October 2007). Department of Water, Land and Biodiversity Conservation, South Australia.

EA (2000). *Revision Of The Interim Biogeographic Regionalisation For Australia (IBRA) And Development Of Version 5.1: Summary Report.* Environment Australia, Canberra.

Ehmann, H. (2005). *South Australian Rangelands and Aboriginal Lands Wildlife Management Manual.* Department of Water, Land and Biodiversity Conservation, South Australia.

Environment Australia (2001). *A Directory of Important Wetlands in Australia,* Third Edition. Environment Australia, Canberra.

Epic Energy (2007) *QSN Link Pipeline Draft Statement of Environmental Objectives*. Document prepared by RPS Ecos for Epic Energy, November 2007.

Geodynamics (2003). *Statement of Environmental Objectives, Cooper Creek / Burley Water Hole Water Extraction & Pipeline Construction and Operation, Cooper Basin, South Australia.* Geodynamics Limited, March 2003. Available at: http://www.pir.sa.gov.au/__data/assets/pdf_file/0006/27438/final_habanero1_cooperck_seo_april2003.pdf.

HLA ENSR (2007). Flora and Fauna Assessment QSN Link Gas Pipeline: South Australian Section. Unpublished report to RPS Ecos.

Krieg, G.W., Callen, R.A., Gravestock, D.I. and Gatehouse, C.G. (1990). *Geology*. In Tyler, M.J., Twidale, C.R., Davies, M. and C.B. Wells (eds) *Natural History of the North East Deserts*. Royal Society of South Australia, Adelaide.

Kotwicki, V. (1986). *Floods of Lake Eyre*. Engineering and Water Supply Department, Adelaide

Laut, P., Heyligers, P.C., Kieg., Loffler, E., Margules, C., Scott, R.M., and Sullivan, M.E. (1977). *Environments of South Australia*. Division of Land Use Research, CSIRO, Canberra.

Leach, G.J. (1989). Adelaide Botanical Gardens 11 (2) 95.

Maslin, B.R. (2001). *Wattle – Acacias of Australia*. Interactive CD. Department of Conservation and Land Management, Perth.

Marree SCB (2004) *Marree Soil Conservation Board District Plan*. *Revised 2004.* Marree Soil Conservation Board. Available at http://www.saalnrm.sa.gov.au/BoardDocuments/Plans.aspx.

McDonough, R. (2000). *Petroleum licensing in South Australia*. Primary Industries and Resources South Australia.

Moseby, K.E., Brandle, R. and Adams, M. (1999). Distribution, habitat and conservation status of the rare dusky hopping-mouse, *Notomys fuscus* (Rodentia: Muridae). *Wildlife Research* 26:479-494.

Moseby, K.E., Owens, H., Brandle, R., Bice, J.K. and Gates, J. (2006). Variation in population dynamics and movement patterns between two geographically isolated populations of the dusky hopping mouse (*Notomys fuscus*). *Wildlife Research* 33:223-232.

NLWRA (2002). *Australian Terrestrial Biodiversity Assessment 2002*. National Land and Water Resources Audit, Land and Water Australia, Canberra.

Northcote, K.H., with G.G. Beckmann, E. Bettenay, H.M. Churchward, D.C. van Dijk, G.M. Dimmock, G.D. Hubble, R.F. Isbell, W.M. McArthur, G.G Murtha, K.D. Nicolls, T.R. Paton, C.H. Thompson, A.A. Webb, and M.J. Wright. (1960-1968). *Atlas of Australian Soils.* Sheets 1-10, with explanatory booklets. CSIRO and Melbourne Univ. Press, Melbourne. Accessed via Interactive Resource and Tenure Maps (http://www.webgis.nrm.qld.gov.au) and via Bureau of Rural Sciences (1991).

NRW (2007). WaterShed (Station 003103A: Cooper Creek at Nappa Merrie). http://www.nrw.qld.gov.au/watershed/ (accessed 11 October 2007). Department of Natural Resources and Water, Queensland.

Puckridge J.T., Costelloe, J.F. and Walker, K.F. (1999). *DRY/WET: Effects of changed water regime on the fauna of arid zone wetlands (CD-ROM model and documentation)*. Report to National Wetlands Research & Development Program: Environment Australia and Land and Water Resources Research & Development Corporation, Canberra. ISBN: 0-642-47326-9

Queensland Government (1974) Queensland Department of Primary Industries (QDPI), *Western Arid Region Land Use Study – Part 1. Technical Bulletin No. 12*.

Qld Herbarium (2006). Personal Communication. Queensland Herbarium Advisory Services. 28 March 2006.

Santos (2000) *Environmental Procedures for the Construction, Operation and Abandonment of Pipelines in the Cooper basin.* Santos, September 2000.

SEA (1989). *The Impact of Seismic Lines in Gibber Land Units*. Prepared for Santos Limited by Social and Ecological Assessment Pty Ltd.

SEA (1992). *South West Queensland Gas Project Environmental Impact Assessment Final Report.* Prepared for Santos Limited by Social and Ecological Assessment Pty Ltd, August 1992.

SEA (1999). Seismic Line Environmental Risk Assessment. Prepared for Santos Ltd – Queensland and Northern Territory Business Unit. Social and Ecological Assessment Pty Ltd, Adelaide.

Tjandraatmadja, G, Gould, S and Burn, S (2005). Analysis of Hydrostatic Test Water - Final Report for APIA. CSIRO Manufacturing and Infrastructure Technology. CMIT Report Number: CMIT–2005–259.

Western Australian Herbarium (2007). FloraBase – The Western Australia Flora. http://florabase.calm.wa.gov.au/. 06 August 2007.

# 9 Abbreviations

| | |
|---|---|
| ºC | Degrees Centigrade |
| ANZECC | Australian and New Zealand Environment and Conservation Council |
| APIA | Australian Pipeline Industry Association Inc |
| AS 1940 | Australian Standard *AS 1940 Storage and Handling of Flammable and Combustible Liquids* |
| AS 2885 | Australian Standard *AS 2885 Pipelines – Gas and Liquid Petroleum* |
| BDBSA | Biological Database of South Australia |
| BoM | Bureau of Meteorology |
| CEMP | Construction Environmental Management Plan |
| DEH | Department for Environment and Heritage (South Australia) |
| DEWR | Department of the Environment and Water Resources (Commonwealth)<br>(formerly the Department of the Environment and Heritage) |
| DTEI | Department of Transport, Energy & Infrastructure (South Australia) |
| DWLBC | Department of Water, Land & Biodiversity Conservation (South Australia) |
| EIR | Environmental Impact Report prepared in accordance with Section 97 of the South Australian *Petroleum Act 2000* and Regulation 10 |
| ELL | Environmental Line List |
| EMP | Environmental Management Plan |
| EMS | Environmental Management System |
| EPA | Environment Protection Authority |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth) |
| EWP | Environmental Work Procedure |
| GIS | Graphic Information System |
| h | hours |
| ha | hectares |
| HDD | Horizontal directional drilling |
| IBRA | Interim Biogoegraphical Regions of Australia |
| km | kilometre |
| KP | Kilometre Point |
| km/h | kilometres per hour |
| L/s | litres per second |
| m | metre |
| $m^3$ | cubic metre |
| MAOP | Maximum Allowable Operating Pressure |
| MAP | Moomba to Adelaide Pipeline (gas) |
| ML | Megalitre ($10^6$ litres) |
| mm | millimetre |
| MPa | mega pascal |
| MSP | Moomba to Sydney Pipeline |
| NPW Act | *National Parks and Wildlife Act* 1972 (South Australia) |
| PL | Pipeline Licence |
| PIRSA | Primary Industries and Resources, South Australia |

| | |
|---|---|
| QSN | Queensland to South Australia/New South Wales Link |
| RNE | Register of the National Estate |
| RTU | Remote Telemetry Unit |
| ROW | Right-of-way |
| SCADA | Supervisory Control and Data Acquisition |
| SCB | Soil Conservation Board |
| SEB | Significant Environmental Benefit |
| SEO | Statement of Environmental Objectives |
| SMYS | Specified minimum yield stress |
| SWQP | South West Queensland Pipeline |
| TJ | Terajoules ($10^{12}$ Joules) |

# 10 Glossary

| | |
|---|---|
| battered | Recontoured to provide a stable angle of slope. |
| bellhole | An enlarged area of trench. |
| berms | Banks of soil placed on slopes to prevent erosion. |
| blowdowns | The deliberate controlled venting or release of gas from a pipeline or associated equipment into the atmosphere (e.g. during maintenance, testing or emergencies). |
| borrow pit | Surface excavation for the extraction of materials such as sand or clay. |
| bund | An earth, rock or concrete wall constructed to prevent the inflow or outflow of liquids. |
| cathodic protection system | Application of an electrical current to the pipeline exterior to prevent the electrochemical process of corrosion occurring. |
| clear-and-grade | The preparation of the right-of-way for vehicular movement, trenching and other construction activities, involving clearing vegetation and other obstacles from the right-of-way, grading topsoil to the edge of the right-of-way, and creating a safe working surface (and slope) for construction. |
| cold-bent | Use of a bending machine to bend sections of pipe in the field (as opposed to hot bending in a factory or workshop where heat is used to bend pipe at much sharper angles). |
| compressor station | An above-ground pipeline facility, at which large engines or turbines are used to compress gas in or entering the pipeline, typically to increase pipeline pressure and throughput. |
| custody transfer metering | Equipment that measures the amount of gas flowing through the point at which gas changes custody (e.g. where it leaves a transmission pipeline and enters another pipeline or a distribution network). |
| easement | A right held by the proponent to make use of the land for the installation and operation of a pipeline. Also referred to as a right-of-way. |
| ephemeral | Existing for only a short time, often dependant upon climatic influences. |
| fugitive emissions | Substances that escape to air from a source not associated with a particular process, such as leaks from equipment. |
| gathering line | A pipeline used to relay raw gas, condensate or oil from a well to a processing plant. |
| gibber | Small to medium weathered rounded stones that form a relatively flat extensive pavements on plains and gentle slopes. The narrow spaces between stones have soil infill. The stones are concentrated on the surface by their gradual downward movement as the soil that once separated them in the vertical dimension has been removed by wind and gentle water erosion. |
| grading | Levelling of the right-of-way using graders, backhoes and bulldozers. |
| horizontal directional drilling | One method by which a pipeline trench is drilled at a shallow angle under a crossing (e.g. a stream bed, major road, railway) through which the pipe is threaded. |
| hot tap or hot tapping | Making a connection into a pipeline in which gas is flowing. |
| hydrostatic testing (or hydrotesting) | A means to check the pipeline for strength and leaks prior to operation in which the pipeline is filled with water and the pressure increased and monitored under controlled conditions. |
| intelligent pig | Electronic device inserted into the pipeline at regular intervals (for example, every ten years) to clean and check the integrity of the line. |
| KP, kilometre point | The approximate distance along the proposed alignment from the beginning of the pipeline. |

| | |
|---|---|
| line list | A document for construction contractors which itemises the management procedures to be undertaken and which gives site specific information for field operators. |
| mainline valves | Valves located in a pipeline at intervals along its length. |
| meter stations | Facility where the flow of gas is measured, particularly where gas is to be reticulated or transferred to local gas users. |
| Native Vegetation Council | A council established under the South Australian *Native Vegetation Act 1991* to assess vegetation clearance applications. |
| oxygen scavenger | A chemical added to water used for hydrostatic testing which inhibits corrosion in the pipeline by removing dissolved oxygen from the water. Commonly used oxygen scavengers include sodium sulphite, sodium bisulphite, sodium metabisulphite and ammonium bisulphite. |
| padding | Fine grained soil placed in the trench to protect the pipeline coating from rock damage. |
| pig | A tool which is inserted into the pipeline and carried by the gas flow to clean the pipe wall, separate the gas, or inspect the pipeline. |
| pig receiver | An above ground facility used to launch and receive pigs which have been inserted into the pipeline system. |
| pipeline alignment | The exact position of the pipeline (or easement) within the corridor. |
| purging | Removing all air from the pipeline, using gas. |
| radiography | Non-destructive examination of pipeline welds using X-ray to detect any defects. |
| Ramsar wetland | A Wetland of International Importance listed under the Ramsar Convention (held in Ramsar, Iran 1971). |
| right-of-way | A cleared area required to install the pipeline. Also referred to as an easement. |
| ripping | The use of machinery to rake or shallow plough soil to relieve compaction and aerate soil. |
| scarifying | The creation of shallow incisions or furrows in soil, usually by using machinery with tynes, in order to loosen compaction and allow the infiltration of water and seeds |
| shading | Fine grained soil placed in the trench after the pipe has been lowered in the trench to protect the sides and top of the pipe from abrasion. |
| skids | Timber blocks similar to railway sleepers used to keep the pipeline off the ground. |
| stringing | Laying the pipe adjacent the pipeline trench. |
| trench or sack breakers | Sandbags placed in the trench to prevent the longitudinal flow of water, which may cause subsidence over the pipeline. |
| trench plug | Short section of trench left unexcavated to allow passage of stock or wildlife across the trench. |
| trench spoil | Soil from the pipeline trench. |
| trench water | Water (usually shallow groundwater) in the pipeline trench. |
| turbidity | Interference with the passage of light through water caused by suspended matter. |
| venting | The deliberate release of gas from a pipeline into the atmosphere (e.g. during maintenance, testing or emergencies). |
| wellhead | The part of an oil or gas well which terminates at the surface, where oil or gas can be withdrawn. |

# Appendix 1: Epic Energy's Environmental Policy

epic energy

## *ENVIRONMENTAL POLICY*

### Epic Energy will Operate in an Environmentally Friendly Manner

Epic Energy is a large gas transmission company who constructs, owns, and/or operates gas transmission pipelines throughout Australia. Epic is committed to minimising the impact of its activities on the environment in keeping with its belief that companies should be increasingly responsible in their management of environmental issues.

To achieve this objective, Epic will:

- Comply with all relevant environmental legislation and the requirements of industry standards as a minimum requirement.
- Integrate care for the environment into the responsibilities and work ethics of all personnel.
- Continue to adopt appropriate new technologies and best practices that reduce the impact of its activities on the environment.
- Minimise land and habitat disturbance by applying environmentally sustainable solutions.
- Promote open communication with landholders and interested parties.
- Avoid disturbance to known or identifies sites of cultural, historical, natural or scientific significance.
- Implement work practices to minimise erosion and sedimentation impacts on neighbouring properties and land.
- Develop opportunities for recycling and more efficiently using energy, water and other resources.

Environmental performance will be monitored regularly and the information communicated to all employees and interested parties/members of the community.

Steve Banning
Managing Director
August 2007

# Appendix 2: Preliminary Calculations for Native Vegetation Act 'Significant Environmental Benefit'

# Preliminary Calculations for Native Vegetation Act 'Significant Environmental Benefit'

The South Australian *Native Vegetation Act 1991* and the *Native Vegetation Regulations 2003* apply to vegetation clearance for petroleum pipeline construction. Under Regulation 5(1)(zd), operations authorised under the *Petroleum Act 2000* are permitted to clear native vegetation, provided that either:

- the clearance is undertaken in accordance with a Statement of Environmental Objectives (SEO) and the Native Vegetation Council has signified that, as a result of work undertaken in accordance with the SEO, there will be a 'significant environmental benefit' (SEB) at the site of the operations or within the same region of the State, or
- the project makes a payment into the Native Vegetation Fund of an amount considered by the Native Vegetation Council to be sufficient to achieve a 'significant environmental benefit'.

This appendix sets out the method of calculation that will be used to determine the size of the 'significant environmental benefit' (SEB) required under the *Native Vegetation Act 1991* for construction of the QSN Link Pipeline.

This document also provides estimates of likely vegetation clearance and of the resulting SEB requirement. However, the actual clearance and actual SEB requirement can only be confirmed following pipeline construction, when the actual width of the construction area and the extent of areas where it is narrowed can be assessed. Consequently, it is proposed that the calculations for vegetation removal and SEB requirement will be finalised after the completion of construction.

<u>Area of Vegetation Impacted</u>

Based on a construction width of 30 m and a length of 91.5 km in South Australia, approximately 280 ha will be subject to temporary disturbance for construction of the pipeline, camp and other work sites.

It is noted that this is likely to overestimate the area where native vegetation is actually removed, for the following reasons:

- the vegetation present is sparse in many areas. Although essentially all the area traversed is vegetated with 'native vegetation', there are many bare areas, and the total cover in many other areas is very low, particularly if annual and ephemeral species (which are likely to be minimally impacted by pipeline construction) are excluded.
- significant vegetation (e.g. large trees) can be left standing within the area that is 'cleared' for the pipeline construction right-of-way.

The majority of the disturbance involved in pipeline construction is temporary. The construction right-of-way will be rehabilitated following construction. Good regeneration of native vegetation on the right-of-way is expected[3] because soil disturbance is short term, topsoil and any seedstock it contains will be replaced, the right-of-way is narrow and seed sources are available adjacent to it to allow recolonisation, and weed levels are low so competition from weeds will be low.

<u>Type and Significance of Vegetation Present</u>

Vegetation communities identified along the pipeline are discussed in Section 5.4, and listed in Table A2-1 below.

None of the vegetation communities identified on the pipeline route or mapped in the broader area are listed as Critically Endangered, Endangered, Vulnerable or Of Concern under the Commonwealth *Environment Protection and Biodiversity and Conservation Act 1999 (*EPBC Act) or the DEH Provisional List of Threatened Ecosystems (DEH in progress).

---

[3] Although there are no data available on regeneration on a pipeline right-of-way in the region, evidence from studies of historic seismic lines in the region (which used outdated practices involving significant soil disturbance) has shown that good regeneration of native vegetation occurs unless poor soil management has resulted in erosion.

**Table A2-1: Vegetation Communities on the Pipeline Route**

| Vegetation Community | Estimated Area on 30m right-of-way (ha) |
|---|---|
| Low riparian Coolibah (*Eucalyptus coolabah*) woodland | 0.3 |
| Very low open Coolibah woodland on floodplain | 86.8 |
| Low Coolibah woodland over Queensland Bluebush (*Chenopodium auricomum*) and Lignum (*Muehlenbeckia florulenta*) open shrubs on floodplain lake. | 0.9 |
| Chenopod (*Atriplex* and *Chenopodium* spp) and Lignum open shrubland on floodplain | 31.1 |
| Grass/herbland on floodplain | 53.5 |
| Very low open *Acacia* woodland on drainage line through stony (gibber) plain | 0.3 |
| Low open Mitchell Grass (*Astrebla pectinata*) tussock grass/herbland on stony (gibber) plain | 51.0 |
| Very open *Acacia* and *Senna* spp. shrubland over open grasses and herbs on low sand dunes and swales | 21.0 |
| Sandhill Cane Grass (*Zygochloa paradoxa*) ± Spinifex (*Triodia basedowii*) open grassland on sand dunes | 11.1 |
| Grass/herbland on low sand dunes | 18.5 |

No rare or threatened plant species were observed during the survey. Whilst the occurrence of such flora species cannot be completely ruled out, it is considered that if any are present, they would be in very low numbers.

Calculation of SEB Requirement

The Native Vegetation Act or Regulations do not explicitly define SEB or prescribe the extent of SEB. Guidelines[4] have been developed for the minerals and petroleum industry to provide a flexible framework for determining the level and method of SEB.

The Guidelines provide a method for calculation of 'set-aside' area, based on the area cleared multiplied by the 'SEB ratio'. The SEB ratios vary from 2:1 to 10:1, depending on vegetation condition. The Guidelines suggest a reduction of the SEB ratio by 50% if on-site re-vegetation (ecological restoration) is carried out following completion of activities.

The Guidelines focus mainly on longer term disturbance (e.g. mine sites and petroleum production sites) and they do not specifically deal with pipeline construction, particularly in arid areas of the state. It is noted that the impacts of the proposed pipeline construction (with the exception of removal of mature trees) are short term and predominantly reversible, and are thus more similar to petroleum exploration, which does not have an SEB requirement.

Consequently, Epic Energy proposes that a more flexible approach be taken to determining appropriate SEB requirements, and proposes to hold discussions with PIRSA and the Native Vegetation Council to determine an appropriate requirement. One suggested approach is to reduce the area of vegetation that has been considered to be 'cleared' to discount areas of predominantly ephemeral vegetation communities that are intersected by the pipeline.

[4] Dept. of Water, Land & Biodiversity Conservation (2005) *Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the clearance of native vegetation associated with the minerals and petroleum industry*. Prepared for the Native Vegetation Council, September 2005.

SEB Ratio

The project area has been subject to historic and ongoing grazing pressure from sheep, cattle, rabbits and other introduced herbivores. The vegetation structure has consequently been altered by selective grazing of various strata, but there are few weeds and most seed sources are likely to be available to regenerate the original structure. Vegetation in the region has not been actively cleared except where required for development of infrastructure.

Consequently, it is considered that the vegetation condition for the pipeline route falls under the Guidelines' category of: *Native vegetation with some disturbance*. The Initial SEB assessment ratio for *Native vegetation with some disturbance*, based on Table 1 of the Guidelines is 6:1 (area).

If the Guidelines are used to calculate the SEB requirement, they indicate that the SEB ratio should be reduced by 50% because on-site restoration will be undertaken i.e. the ratio becomes 3:1.

Proposed SEB

As discussed above, it is proposed that the SEB requirement be discussed with PIRSA and the Native Vegetation Council to determine an appropriate requirement.

# Appendix 3: Flora and Fauna Information

**Table A3.1: Rare or Threatened Flora Resulting from Database Searches**

| Family | Scientific Name | Conservation Status* | Preferred Habitat | Preferred Habitat Present | Identified During Survey |
|---|---|---|---|---|---|
| Mimosaceae | *Acacia peuce* | V[1] | Occurs on fixed shallow sand aprons over clay and gibber slopes, also associated with alluvium and paleo-channels of the Hamilton and Georgina Rivers (Maslin, 2001). | Y | N |
| Mimosaceae | *Acacia pickardii* | V[1] and R[2] | Occurs on gibber-covered sandplains and in stony sand over clay on low residual mesas and adjacent flats. Soils are crusty alkaline and neutral red duplex (DEWR 2007a). | Y | N |
| Mimosaceae | *Acacia tenuissima* | R[2] | Eucalypt woodland, often with Spinifex, in sandy soils (DEWR 2007c). | Y | N |
| Chenopodiaceae | *Atriplex morrisii* | V[2] | Information not available. | Y | N |
| Elatinaceae | *Bergia occultipetala* | V[2] | In sandy soils, on the lower slopes of dunes and swamp margins (Leach 1989). | Y | N |
| Cyperaceae | *Bulbostylis turbinata* | R[2] | Occurs on red loam, sand and brown clay, along watercourses, in depressions and rockholes (WA Herbarium 2007). | Y | N |
| Callitrichaceae | *Callitriche sonderi* | R[2] | Occurs in damp areas liable to inundation (Botanic Gardens Trust 2007). | Y | N |
| Cyperaceae | *Cyperus bifax* | R[2] | Grows on floodplains on heavy clay soils (Botanic Gardens Trust 2007). | Y | N |
| Cyperaceae | *Cyperus dactylotes* | V[2] | Grows in seasonally wet situations, such as stream banks and roadside drains (Botanic Gardens Trust 2007). | Y | N |
| Myoporaceae | *Eremophila polyclada* | R[2] | On the banks and floodplains of Cooper Creek and the Murray River (DEH 2007). | Y | N |
| Frankeniaceae | *Frankenia cupularis* | R[2] | Sand flats and salt pans, in semi-arid districts (Botanic Gardens Trust 2007). | Y | N |
| Frankeniaceae | *Frankenia plicata* | R[2] | Information not available. | Y | N |
| Sterculiaceae | *Gilesia biniflora* | R[2] | Saline clay soils. | Y | N |
| Proteaceae | *Grevillea kennedyana* | V[1] | Found on rocky sites, typically the colluvium slopes of mesas & jump ups; occasionally in dry rocky watercourses (Qld Herbarium, 2006). | Y | N |

| Family | Scientific Name | Conservation Status* | Preferred Habitat | Preferred Habitat Present | Identified During Survey |
|---|---|---|---|---|---|
| Scrophulariaceae | *Mimulus prostratus* | R[2] | Grows on margins of swamps or watercourses, or in temporarily inundated areas, sometimes in saline site (Botanic Gardens Trust 2007). | Y | N |
| Menyanthaceae | *Nymphoides crenata* | R[2] | Grows in slow-flowing water to c. 1.5 m deep, usually on a mud substrate, can persist on drying mud (Botanic Gardens Trust 2007). | Y | N |
| Ophioglossaceae | *Ophioglossum polyphyllum* | R[2] | Occurs in moist places in dry regions (Botanic Gardens Trust 2007). | Y | N |
| Chenopodiaceae | *Osteocarpum acropterum* var. *deminutum* | R[2] | Usually found in heavy periodically waterlogged soil (DEH 2007). | Y | N |
| Chenopodiaceae | *Osteocarpum pentapterum* | E[2] | In heavy soil subject to flooding (DEH 2007). | Y | N |
| Cruciferae | *Phlegmatospermum eremaeum* | R[2] | Stony loam (WA Herbarium 2007). | Y | N |
| Thymelaeceae | *Pimelea penicillaris* | R[2] | On sandy soils (DEH 2007). | Y | N |
| Chenopodiaceae | *Sclerolaena blackiana* | R[2] | On plains and low slopes with brown soils and cracking clays (Qld Herbarium, 2006). | Y | N |
| Chenopodiaceae | *Sclerolaena holtiana* | R[2] | Northern SA (Barker (Ed.) *et al* 2005). | Y | N |
| Cerithiidae | *Stylidium desertorum* | V[2] | Adjacent to seasonal swamps, in areas which receive runoff, or on sandplains in association with *Triodia* spp. Usually in sandy soils, but also clay and clay-loams (Bean 1999). | Y | N |
| Leguminosae | *Swainsona oligophylla* | R[2] | Usually on clay-loam soils in well-watered areas, especially on floodplains (Botanic Gardens Trust 2007). On sandy soils (DEH 2007). | Y | N |
| Zygophyllaceae | *Zygophyllum humillimum* | R[2] | Red-brown cracking clay and sandy loam with gypsum (Botanic Gardens Trust 2007). | Y | N |

Status 1 Commonwealth (EPBC) listed – E = Endangered, V = Vulnerable

2 State (NPW Act) listed – E = Endangered, V = Vulnerable, R = Rare

**Table A3.2: Impact Class Assessment of Rare or Threatened Fauna with Preferred Habitat within the Corridor**

| Common Name | Species Name | Ecology and Distribution notes | Potential Impacts | Likelihood of Presence* | Impact Class** |
|---|---|---|---|---|---|
| **Birds** | | | | | |
| Australian Painted Snipe | *Rostratula australis* | Cryptic nomadic bird of shallow wetlands, nests on ground in reeds close to water. May potentially utilise wetlands along most of route. | Habitat loss (wetlands). | L | 2 |
| Grey Grasswren (Bulloo) | *Amytornis barbatus barbatus* | Restricted to Bulloo floodplain on Qld-NSW border, over 150 km SE of route. Proposed route is outside range, as Bulloo subspecies is genetically distinct from Cooper Creek population, indicating a strong barrier to dispersal. | No significant impacts. | L | 1 |
| Australian Bustard | *Ardeotis australis* | Large nomadic bird of open country. May irrupt following good conditions. Nests on the ground and readily deserts nests in response to disturbance, but breeding generally occurs in northern Australia. Recently recorded near Innamincka, and potentially present along entire route. | No significant impacts. | M | 1 |
| Bush Stone-curlew | *Burhinus grallarius* | Requires fallen logs and tree debris on the ground for shelter and camouflage. One recent record from the area, from Coongie Lakes. Potentially present in suitable open woodland habitat along the route. | Habitat disturbance (woodland, logs and litter) | L | 2 |
| Brown Quail | *Coturnix ypsilophora* | Prefers denser grasslands, esp. around margins of lakes and swamps. One recent record in the study area, from near Innamincka. May occur along route in good years. | No significant impacts. | L | 1 |
| Brolga | *Grus rubicunda* | Large wetland bird that moves to follow good rains. Recorded along Cooper Ck near Innamincka, and may occur on floodplain sections of the route when inundated. | No significant impacts. | M | 1 |
| Flock Bronzewing | *Phaps histrionica* | Nomadic and irruptive in response to good conditions. Recorded during field survey at waterhole at KP 136, and potentially present suitable habitat along entire route. | No significant impacts. | H | 1 |
| Freckled Duck | *Stictonetta naevosa* | Nomadic across southern and central Australia, with occupancy of wetlands determined by flows. Previously recorded on Cooper Ck near Innamincka. Potential occurrence in wetlands along route when inundated. | No significant impacts. | M | 1 |

| Common Name | Species Name | Ecology and Distribution notes | Potential Impacts | Likelihood of Presence* | Impact Class** |
|---|---|---|---|---|---|
| Australasian Shoveler | *Anas rhynchotis* | Nomadic and dispersive across SE and SW Australia, Previously recorded on Cooper Ck east of Innamincka. Potentially occurs in wetlands along route in good years. | No significant impacts. | M | 1 |
| Red-winged Parrot | *Aprosmictus erythropterus* | Nests in hollows. Previously recorded along Cooper Ck near Innamincka and potentially present in Riparian Woodland and Floodplain Coolibah Open Woodland with hollows along route. | Habitat loss (hollows) | M | 2 |
| Intermediate Egret | *Ardea intermedia* | Occupies a range of freshwater wetlands. Previously recorded along Cooper Ck near Innamincka, and may occur on floodplain sections of the route when inundated. | No significant impacts. | M | 1 |
| Musk Duck | *Biziura lobata* | Previously recorded along Cooper Ck near Innamincka and may occur on floodplain sections of the route when inundated. | No significant impacts. | L | 1 |
| Red-tailed Black-Cockatoo | *Calyptorhynchus banksii* | Nests in large tree hollows; nomadic. Previously recorded along Cooper Ck near Innamincka and potentially present in and around Riparian Woodland along Strzelecki Ck (KP 118.8). | Habitat loss (nest trees). | L | 2 |
| White-browed Treecreeper | *Climacteris affinis* | Nests in hollows, Previously recorded along Cooper Ck near Innamincka. and potentially present in Riparian Woodland and Floodplain Coolibah Open Woodland with hollows along route. | Habitat loss (nest trees). | M | 2 |
| Grey Falcon | *Falco hypoleucos* | Widespread but rare along inland watercourses. Nests in the tallest trees along watercourses. Recorded during field survey at KP 122, just west of Strzelecki Ck. Nesting habitat potentially present in Riparian Woodland in the vicinity of Strzelecki Ck (KP 118.8). | Habitat loss (nest trees). | H | 2 |
| Black-breasted Buzzard | *Hamirostra melanosternon* | Nests in large trees along watercourses. Recorded during the field survey at KPs 107 and 121 and previously recorded near Innamincka and Moomba. Nesting habitat potentially present in Riparian Woodland in the vicinity of Strzelecki Ck (KP 118.8). | Habitat loss (nest trees). | H | 2 |
| Barking Owl | *Ninox connivens* | Nests and roosts in large hollows, especially in riparian vegetation. Previously recorded along Cooper Ck near Innamincka and potentially present in Riparian Woodland along Strzelecki Creek. | Habitat loss (hollows) | L | 2 |
| Blue-billed Duck | *Oxyura australis* | Occupies a range of wetlands, relatively sedentary. Recorded during field survey in wetland at KP 153 and previously recorded along Cooper Ck near Innamincka. | Habitat disturbance (wetlands) | H | 2 |

| Common Name | Species Name | Ecology and Distribution notes | Potential Impacts | Likelihood of Presence* | Impact Class** |
|---|---|---|---|---|---|
| Glossy Ibis | *Plegadis falcinellus* | Nomadic, occupies a range of shallow wetlands. Previously recorded along Cooper Ck near Innamincka and may occur on floodplain sections of the route when inundated. | No significant impacts. | M | 1 |
| Great Crested Grebe | *Podiceps cristatus* | Irregular visitor to arid areas following good conditions. Previously recorded along Cooper Ck near Innamincka and may occur on floodplain sections of the route when inundated. | No significant impacts. | L | 1 |
| **Mammals** | | | | | |
| Dusky Hopping-mouse | *Notomys fuscus* | Digs burrows on the crests of sand dunes. Previously recorded in dunefields in Strzelecki Desert and south of Innamincka, and potentially present in dunefield habitat between KP 116 – 182. | Direct impact (unearthing), trenchfall. | M | 3 |

* Likelihood of species' presence in suitable habitat along the proposed alignment: L = Low, M = Moderate, H = High.

** Impact Class: 1 = Significant Impact Unlikely; 2 = Standard Mitigation Acceptable; 3 = Sensitive to Pipeline Impacts; 4 = Insufficiently Known.