Chapter 2
Project Description

PACIFIC **ALUMINIUM**

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2 Project Description

2.1 OVERVIEW

The detailed project description of the proposed Katherine to Gove Gas Pipeline (KGGP) Project is presented as the following key stages:

- Design.
- Construction.
- Commissioning.
- Operation.
- Decommissioning.

Details of the project description presented in this Draft EIS are representative of the preliminary design phases of the project. These details would be refined during the detailed design phase for the KGGP, during which time technical decisions would be made on engineering and construction aspects of the project. Where details are to be confirmed in latter design phases, a range of possible options have been provided and a Site Selection Protocol (Appendix U) has been developed in this Draft EIS, to allow for transparency in the assessment of environmental and social impacts. The Protocol defines a process by which the final location of ancillary infrastructure will be identified by firstly identifying environmental constraints to be avoided in detailed design, identifying any potential additional impacts and alternative locations, field validation of existing and alternative sites and determination of the most suitable location for infrastructure or works.

The KGGP would be 603 km in length and have an external diameter of 324 mm. The project location is presented in Figure 2-1. References to Kilometre Points (KPs) in figures or text relate to the given distance from the commencement of the KGGP at its tie-in with the NT Amadeus Gas Pipeline (KP0).

The KGGP would consist of a buried high-tensile steel pipe, which would generally be constructed within a 30 m wide Right of Way (ROW). However, the pipeline ROW may require widening to 40 m in areas of difficult topography (e.g. ranges or waterway and infrastructure crossings) and in localised areas where additional work spaces are required. The location of the ROW has been determined within a currently defined 100 m wide pipeline corridor. The exact location of the ROW within the pipeline corridor would be determined at the time of survey and pegging.

Supporting infrastructure, including three scraper stations and five main line valves (MLV) would be required to be constructed outside of the construction corridor, as well as one compressor station at King River (KP23.6). Temporary infrastructure required for construction includes five construction camps. Approximately 265 km of existing access tracks and 110-150 km of new access tracks may be required.

The KGGP and associated facilities would be designed, tested, operated, maintained and decommissioned in accordance with relevant legislation, licence conditions, the Australian Pipeline and Industry Association's (APIA) Code of Environmental Practice (2009) and AS2885 'Pipelines–Gas and Liquid Petroleum' (Parts 1, 2, 3 and 5).

The pipeline is planned to be built, operated and owned by Pacific Aluminium with operation and maintenance possibly being subcontracted to an organisation with current experience in management responsibilities for such infrastructure.

To ensure all potential impacts of the KGGP have been considered, a conservative approach has been taken in the following sections where describing aspects of the KGGP, including estimated workforce numbers and number of construction spreads.

The preliminary KGGP design is based on the following key parameters:

- Detailed terrain and risk analyses would comply with all parts of AS2885.
- Operational life of 50 years.
- The number and location of facilities along the pipeline detailed in Section 2.5.

2.2 OBJECTIVES

Pacific Aluminium proposes to construct the KGGP with the aim of transporting gas to the Gove refinery in order to facilitate a more environmentally sustainable and cost effective operation.

The objectives of the KGGP project are to:

- Maintain and sustainably operate the Gove refinery and mining operations.
- Enable the Gove refinery operation to continue to contribute to the regional, Northern Territory and national economies.
- Deliver an ecologically sustainable development that balances economic, ecological and social outcomes.
- Reduce air emissions from the Gove refinery.
- Comply with legislative requirements.
- Avoid or mitigate environmental and social impacts.
- Rehabilitate the landform in areas disturbed to allow for continued land use in the area traversed by the pipeline.

2.3 LOCATION AND SETTING

The overall project envelope is defined by the points in Table 2-1 and shown in Appendix K.

The final location of the KGGP is subject to detailed design but is not expected to vary significantly from the pipeline corridor outlined in Figure 2 1 and set out in more detail in Appendix V. The KGGP would connect (tie-in) with the existing NT Amadeus Gas Pipeline at a location south of Katherine, to be determined in detailed design. There are two options for the tie-in location (other than Figure 2-2 all mapping the Draft EIS reflect the first of these options). The first option follows the same corridor as the previously proposed TTP. The second option would tie in 13 km south of the first option and take a more southerly route until crossing the Stuart Highway (Figure 2-2). This option would reduce the pipeline length and temporary disturbance of land. After crossing the Stuart Highway, the KGGP would then follow an eastern route passing near the community of Beswick, before heading in a north-easterly direction towards Gove.

Table 2-1: Project envelope coordinates

LATITUDE	LONGITUDE
-12.30476	136.86456
-15.21722	132.25792
-14.53194	132.32455
-12.27621	136.76938
-12.18103	136.7789
-12.29524	136.86456
-12.30476	136.86456

The KGGP would cross major watercourses including: King River, Waterhouse River; Mainoru River, Wilton River, Goyder River, Boggy Creek, Cato River, Giddy River and Latram River. The majority of the pipeline route is located on sandy undulating plains.

2.4 PROJECT SCHEDULE

Key milestones for the KGGP Project are broadly as follows:

2012-13 Environmental and land access approvals finalised.

2013 Engineering design.

2014 Pipeline construction.

2015 Gas delivery to the Gove refinery.

Depending on statutory approvals and weather conditions (and subject to delay by 'force majeure' type events), construction would be undertaken between November 2013 and December 2014 with the majority of construction activities ramping up in March 2014 and peaking between July and August. Construction is based on the requirement of first free flow gas to Gove by first quarter 2015 and would be undertaken in two sections or 'construction spreads' primarily over the 2014 dry season. The dry season typically commences in April. The actual cessation of the 2013/14 wet season would be monitored and be followed by a buffer period to allow soil to dry out and watercourse flows to subside before construction commences. This would reduce the risk of delay.

Prior to March 2014, equipment would be mobilised to Katherine and Gove in preparation for commencement of construction and infrastructure works and upgrades, such as road widening and crest lowering. Pipe stockpile preparation would occur from as early as November 2013 at Katherine and Gove, subject to environmental and land access approvals.

Testing of the KGGP would be completed as and when the pipeline sections are constructed. Sections completed and tested in 2014 would be protected, preserved and monitored to ensure that the pipe integrity is maintained until the introduction of gas in 2015.

Pipeline pre-commissioning activities would commence in the fourth quarter of 2014, with 'first gas' delivery to Gove scheduled for the first quarter of 2015.

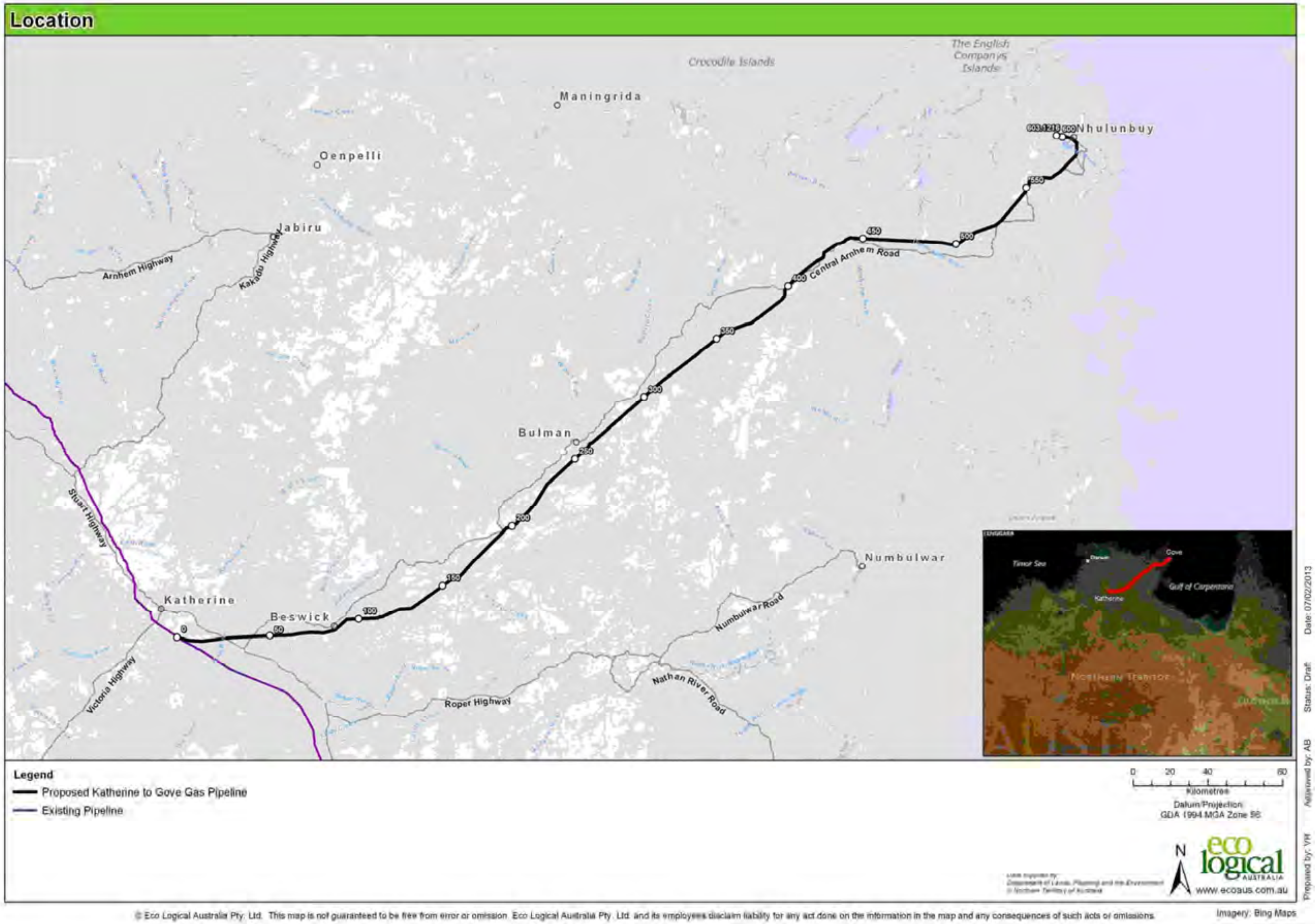

Figure 2-1: Regional location of the proposed Katherine to Gove Gas Pipeline

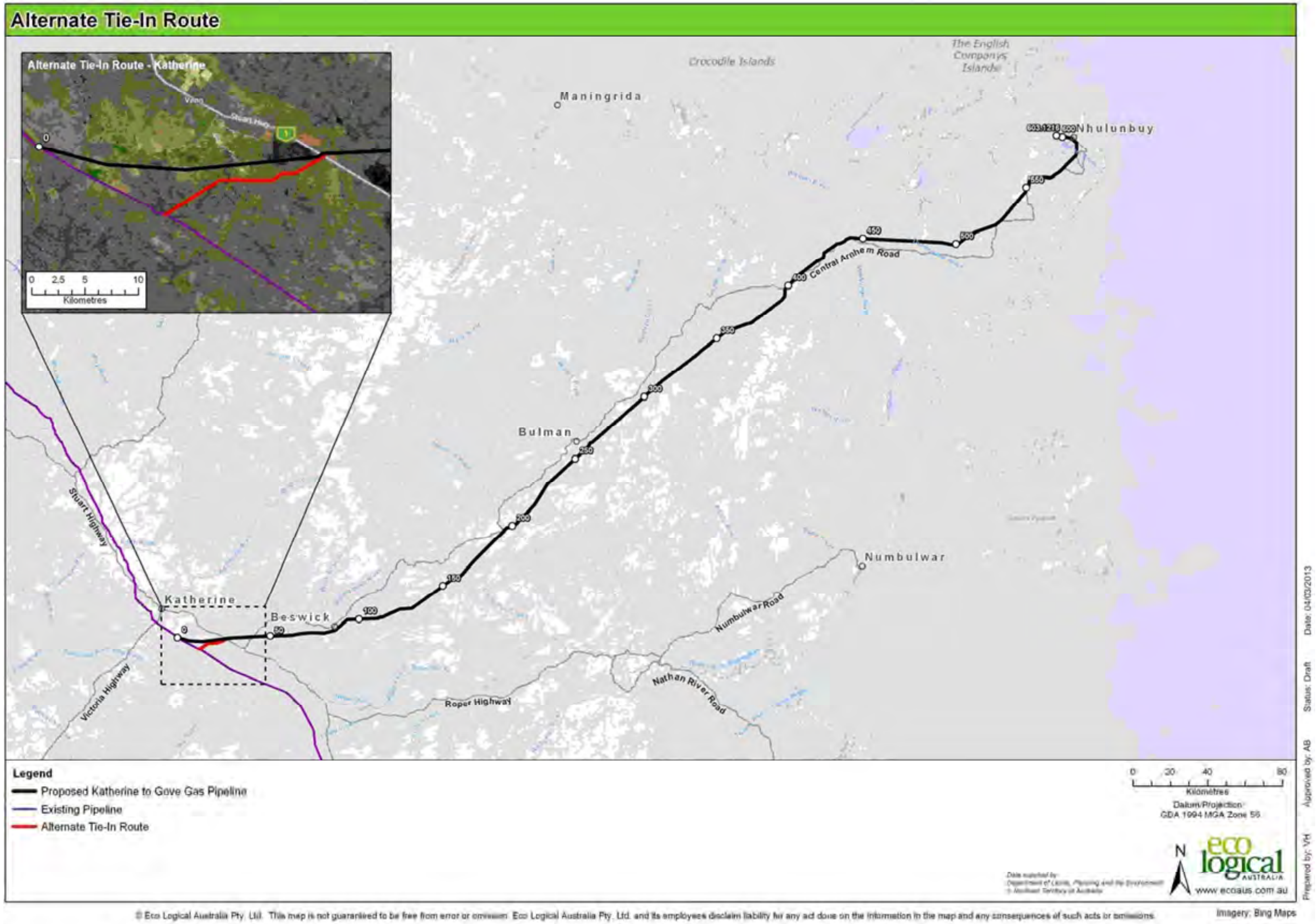

Figure 2-2: Location of alternate tie-in for the Katherine to Gove Gas Pipeline

2.5 DESIGN

2.5.1 Design specifications

Indicative design specifications for the pipeline are presented in Table 2-2. These specifications would be refined and updated during the detailed design phase. Descriptions of ancillary infrastructure such as scraper stations can be found in Section 2.5.4.

Table 2-2: Pipeline design specifications

PARAMETER	SPECIFICATION
Length	603 km (buried)
Standard construction corridor width	30 m
Area of disturbance (including access tracks and ancillary infrastructure)	Up to 2,200 ha
Minimum depth of cover	In accordance with AS 2885.1. Typically 750 mm, and 1,200 mm or greater under waterway, rail and road crossings.
Nominal capacity	34 PJ/a
Maximum outside diameter	324 mm
Minimum wall thickness	6.4 mm
Operating pressure	15.3 MPa
Maximum allowable operating pressure (MAOP)	15.3 MPa
Specific minimum yield stress	485.0 MPa
Corrosion protection	Impressed current
Design life	50 years
Scraper stations	3 off (at each end and one mid line)
Main line valves	5
Pipeline monitoring system	SCADA Pipeline Monitoring System
Hours of construction	Planned to be predominantly day works

2.5.2 Pipeline protection

Corrosion protection

To protect the buried pipeline from atmospheric, chemical or bacterial attack, and from stray currents, (induced by proximity and parallel alignment such as power lines) corrosion protection systems would be installed through a combination of external coating and cathodic protection.

External coating

External coating would be applied to the pipeline lengths as part of the manufacturing process. The coating would consist of a dual layer Fusion Bonded Epoxy (FBE) or trilaminate coating. The pipeline would be factory grit blasted before the protective coating is applied.

Approximately 100 mm at each end of the pipe lengths are left bare and coated after welding. The joint coating that is applied would be compatible with the parent coating material and the quality would be checked against AS2885.

Cathodic protection (CP)

Due to the presence of unavoidable coating defects it would be necessary to install a cathodic protection system. Cathodic protection is an electrical method of preventing pipe corrosion (Figure 2-3).

Temporary cathodic protection would be applied during pipeline construction. At completion of pipeline construction, the temporary cathodic protection system would be disconnected and a permanent impressed current protection system would be commissioned and operated.

The impressed current system utilises a direct current supplied by an external power source to prevent the pipeline from corroding. The CP system places a negative voltage potential onto the pipe, and the positive from the controller is connected to an anode bed. The anode bed consists of a number of buried silicon/cast iron anodes placed in a petroleum coke backfill.

Provision would be made for the installation of anode beds at every scraper and main line facility. A trench would be excavated three metres deep, 600 mm wide and 25 m long and backfilled around the anodes with petroleum coke which acts as the conductor. These beds may be situated up to 200 m perpendicular from the pipeline, depending on the soil resistivity, and would be connected to the pipeline via a buried cable. The anode bed would only be visible by a plastic pipe extending above the ground to allow for ventilation and watering of the anode bed if required and a single terminal box for testing (Figure 2-3).

Anode beds will be located in accordance with the Site Selection Protocol at Appendix U and would be surveyed prior to installation to ensure avoidance of any ecologically or culturally sensitive areas.

Following installation and commissioning, the system would be regularly monitored to ensure the adequacy of protection is maintained. Monitoring would be carried out using test points connected to the pipeline at two to five kilometre intervals. The vertical test point would be visible from the surface as a one metre length of 50 mm diameter galvanised pipe with a small electrical terminal box mounted on the top.

Buoyancy control

Buoyancy control may be applied to certain sections of the pipe to give the pipeline stability where it crosses flood plains or rivers. Buoyancy control options would include:

- Extra depth of cover.
- Geotech fabric control.
- Weight coating (factory or site applied, generally concrete).
- Bolt-on (river) weights.
- Screw anchors.

The type of buoyancy control selected would depend on the soil conditions and would be determined during detailed design. Any coating conducted on site in close proximity to watercourses would be undertaken in accordance with the Provisional Hydrology and Water Quality Management Plan (Appendix O).

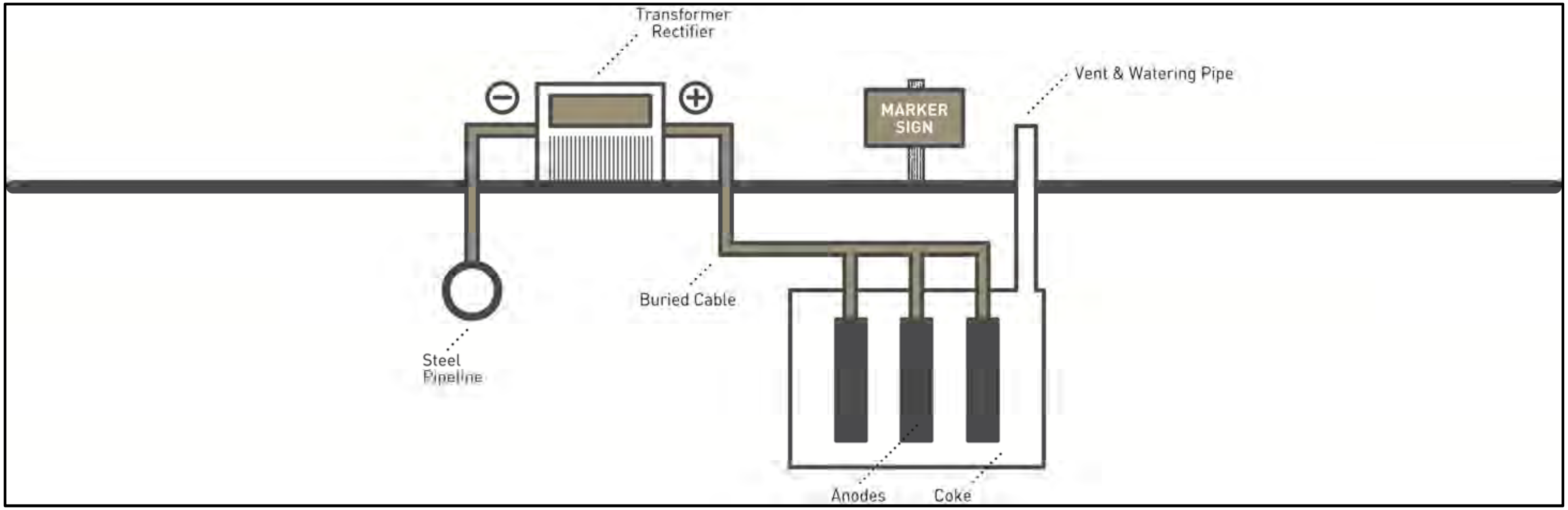

Figure 2-3: Typical anode bed layout. The cathodic protection system is required to prevent pipe corrosion.

Abrasion coating

Mechanical or abrasion protection coating would be applied to sections of the pipeline being prepared for horizontal direct drilling (HDD) (see Section 2.6.5). This coating involves applying a protective jacket to the pipe section. The type of jacket applied would depend on the terrain and installation detail. Often a thin layer of a special hard coating of high solids epoxy is applied to the pipe at the coating yard.

2.5.3 Additional components

Pipeline markers

Pipeline markers would be designed and installed in accordance with AS2885. They indicate the location of the pipeline, and would be installed during reinstatement of the corridor. The markers would be erected at continuously visible locations along the pipeline and specifically be positioned at road and water crossings, fence lines and at changes in direction along the pipeline route. Each marker would be double-sided and would contain the following information:

- Nature of pipeline contents (for example, high pressure gas pipeline).
- Safety instructions (for example 'Do Not Dig').
- Emergency phone number.
- Location of the pipeline.

Aerial markers would be located at 10 km intervals and would be visible from any aerial approach along the construction corridor in either direction.

2.5.4 Supporting facilities

A number of facilities would be required at intervals along the pipeline for safety, maintenance and pipeline integrity purposes. These facilities would include:

- Meter stations.
- Main line valves.
- Scraper stations.
- Compressor station.

The initial location of the pipeline facilities would be determined by hydraulic studies performed during detailed design. However, the final site selections would address the Site Selection Protocol at Appendix U and include a combination of the following factors:

- Availability of existing electrical power.
- Proximity to maintenance centres.
- Access (in particular the compressor station would be provided with all-weather access).
- The distance from housing and other sensitive locations.
- Cultural heritage, land access and environmental approvals.
- Topography and hydrology (e.g. avoid flood prone land).

The proposed location of these facilities along the KGGP route are identified in Table 2-3 and shown on Figure 2-4.

Table 2-3: Location of supporting facilities

METER STATIONS	MAIN LINE VALVES	SCRAPER STATIONS	COMPRESSOR STATION
KP602.7	KP192.5	KP0.0 (Tie-in)	KP23.6 (King River)
	KP297.0	KP297.0	
	KP456.0	KP602.7	
	KP574.5		
	KP590.9		

Meter stations

A meter station would be installed at the end of the pipeline (at the Gove Let-Down Station within the existing Gove Refinery) and would be used to measure the volume of gas exiting the pipeline. The meter station would include a gas analyser and flow computers and would provide information essential for commercial transactions associated with the supply of gas.

Main line valves

In accordance with AS2885, main line valves would be required at intervals along the length of the pipeline as a safety measure to enable the isolation of sections of the pipeline in the event of an emergency or leak. Main line valve facilities would be equipped with vent valves both upstream and downstream of the main line valve to enable venting of the gas from the isolated section. The valve at approximately KP574.5 would incorporate pressure reduction facilities. The main line valves would be buried (apart from the operating handle and the vents that would be located above ground) and would be located within a 12 m by 16 m security fenced area approximately two metres high. Main line valves would be manually operated except for the valve at Nhulunbuy, which would be remotely operated. As shown in Figure 2-4 and detailed in Table 2-3, a total of five main line valves would be installed along the length of the KGGP.

Scraper stations

Scraper stations allow the manual introduction and retrieval of internal mobile inspection and cleaning tools, known as ‘pigs’, into and out of the pipeline during operations. The pigs are launched using the pig launcher, sent through the line using the pressure of the gas, and are retrieved from the pig receiver.

A scraper station will be installed at KP297 as well as a launcher at the pipeline tie-in (KP0) and a receiver at the Gove Let-Down Station (KP603.5). All scraper stations would include isolation valves that may be operated manually or remotely, controlled via a standard industry Supervisory Control and Data Acquisition (SCADA) system (Section 2.8.1). Scraper stations would typically be located within a 20 m by 30 m fenced area situated within the construction corridor. Security fencing would be installed approximately two metres high around the facility. The individual scraper stations may include the following equipment and facilities:

- Pig launcher and pig receiver.
- Valves, including a remotely operated isolation valve.
- A flat roofed, prefabricated building approximately three metres high, standing on pillars up to one metre high.
- Remote Area Power Supply (RAPS) and associated solar panels.
- A satellite dish for Supervisory Control and Data Acquisition (SCADA) communications.

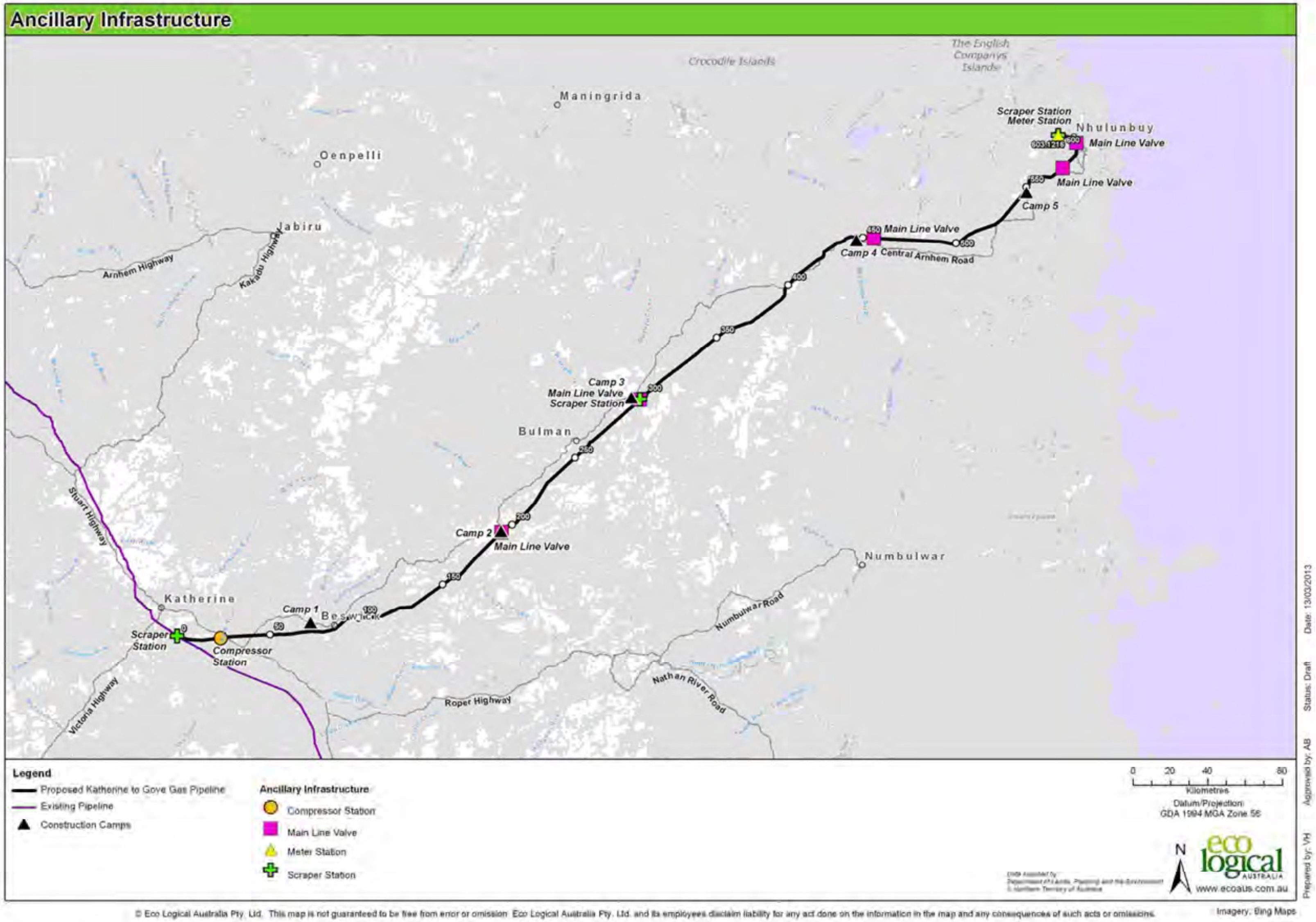

Figure 2-4: Location of supporting facilities

Compressor station

Compressor stations are primarily used to boost the pressure of gas, as the gas demand increases. One compressor station is proposed at KP23.6 (King River). The specific location would be determined in accordance with the Site Selection Protocol (Appendix U).

The compressor station would be located in a cleared area of up to 500 m by 500 m of which approximately 180 m by 230 m would be graded and fenced, with a 15 m buffer around the perimeter. The stack would be the highest component of the compressor station, at a height of approximately 12.5 m. The equipment and above ground facilities are likely to be painted in neutral tones to reduce visual impacts. Trees may also be planted to further screen the station; however a buffer would be left to reduce bushfire risk.

Fencing of the compressor station is necessary to ensure authorised access and exclude stock. The station perimeter would be secured with a stock-proof fence, and the compressor facilities would be enclosed with a security fence, creating a buffer zone between the fences.

The 500 m by 500 m site for the compressor station would be cleared for construction. When operational, a compound of 260 m by 210 m would be maintained and kept free of vegetation to provide protection in the event of a bush fire.

The compression facility would be laid out in such a manner so as to offer the maximum protection to all equipment and personnel. During the design process a site risk assessment would be undertaken to determine all the risks that could impact on safety of the facility, staff and the general public and other stakeholders.

The primary processes that are undertaken at a typical compressor station on receipt of gas from the upstream pipeline section include:

- Gas filtering.
- Compression of gas to a maximum outlet pressure of 15.3 MPa.
- Cooling the gas after compression and prior to pipeline delivery.
- Providing a venting facility for pipeline sections upstream and downstream, and for the compressor station itself.
- Launching and receiving pipeline pigs to/from the pipeline.

The compressor station as a whole would be remotely operated. The compressor station has been designed to act as a stand-alone facility and would not require a 24 hour workforce presence on site. The compressor station would be situated near Katherine and would house a maintenance base, thereby enabling workers to be on site during normal work hours if required and allowing a rapid response to any maintenance situations associated with the compressor station and pipeline.

The exact specifications of the compressor station would be determined during the design phase. Specifications that are representative of standard pipeline design have been provided and the major components of a typical compressor station are detailed in Table 2-4. These components are set out in the order of gas flow through the station.

Table 2-4: Major components of a compressor station

EQUIPMENT IN SEQUENTIAL ORDER
Gas inlet – incorporating a station isolation valve
Filter separator assembly
Gas filter separator (element type filters of approximately five microns)
Turbine fuel gas off-take
Fuel gas skid
Fuel gas metering of system use gas
Unit limit valves (inlet and outlet)
Gas compressors
Gas coolers
Gas outlet – incorporating the station outlet isolation valve
Emergency shutdown system (ESD)
Gas turbine control panel
Station control panel
Outlet pressure transmitter
Station vent system
Other venting devices
Minor venting locations
Station check valves
Ancillary equipment

2.5.5 Gove Let-Down Station

Gas transported through the KGGP will be reduced in pressure as it approaches Gove in order to meet the supply pressures to the distribution network at the Gove refinery. The Gove Let-Down Station provides the first level of pressure reduction and also provides a measurement of the gas for sale to the customer.

The Gove Let-Down Station would be located at the end of the pipeline (KP603) and would have the functions of metering and pressure regulation. The area of land required for the gate station is estimated to be 70 m by 30 m and lies within the fenced area of the existing refinery. The Site Selection Protocol at Appendix U would be addressed in the detailed siting of the facility.

The station would contain the following elements:

- Pig receiver.
- Venting facilities.
- Water bath heaters.
- Filter/separators.
- Gas metering.
- Pressure reduction.

When natural gas is reduced in pressure it also experiences a temperature drop. If the temperature is allowed to fall below a certain point, liquids may form in the downstream pipes, causing problems in the downstream equipment. To avoid liquid dropout, the gas would be heated naturally by ground heat transfer between initial pressure regulation at KP575 and final pressure regulation at KP603.5.

Filter/separators would be used to collect solids and liquids from the pipeline that may damage downstream equipment such as the meters. The filter elements are disposable and would be changed at regular intervals, especially following pigging.

Pressure regulation of the gas would be employed to ensure that a fixed pressure is maintained at the outlet. The regulators are usually self-powered, and use the pressure of the gas to operate, with the result that some minor venting of the gas occurs during operation of the regulators. In order to ensure that the downstream pipework is not over pressured, two regulators would be operated in series, the second valve closing if downstream pressures exceed a set value. An additional safety measure, a slamshut valve, would also be installed which would close if the downstream pressure exceeds a certain value. The pressure reduction system would be duplicated to ensure continuity of gas supply in the event of failure of the primary system.

2.6 CONSTRUCTION

The principal activities to be undertaken to install the pipeline and associated activities are described in the following sections.

2.6.1 Construction ROW methodology

Construction activities for the pipeline would generally be contained within a 30 m wide ROW located within the currently defined 100 m wide pipeline corridor. It may be necessary to increase the width of the ROW over short lengths in certain areas where increased working space is required—such as for constructing river, rail and road crossings and in rocky areas. The ROW is not proposed to be fenced during construction, except at points of public access or deep excavations.

The ROW would be cleared of vegetation (in particular heavy vegetation such as large trees), retaining root stock in the ground where possible, to promote stability and reduce erosion. Approximately 2,200 ha of native vegetation would be cleared along the ROW and for supporting facilities, temporary construction camps and access tracks.

The ROW would be 30 m wide to accommodate the various working widths. Adequate width (approximately 12 m) is required on the non-working side of the trench to allow the vegetation, topsoil and excavated spoil stockpiles to be separated, for the trenching machine to straddle the trench and for the padding machine to operate. Similarly, adequate width (approximately 18 m) is required on the working side of the trench to allow the pipe stringing trucks, welding rigs and lowering-in sidebooms and excavators to traverse alongside the trench, whilst allowing a safe passing lane for trucks and vehicles between this work strip and the stockpiled vegetation and topsoil at the edge of the ROW.

Preparation of supporting facilities

Preparation of areas required to support the construction process would also be required. These areas may include:

- Borrow pits for sand, gravel and rock.
- Camp sites.
- Water storage dams, ground water bores and pipes.
- Truck turning areas that extend beyond the 30 m ROW.

- Additional temporary access tracks.
- Additional space for horizontally bored crossings and HDD watercourse crossings for spoil piles and equipment layout.
- Additional space at open-cut watercourse crossings (for separate bank material and excavated spoil stockpiles) and where areas of rock are encountered.

The locations of these sites will be determined during the design phase in accordance with the Site Selection Protocol at Appendix U, taking into account existing ground conditions and logistical issues.

Topsoil stripping and grading

The centreline of the pipeline route would be graded and levelled to the required gradient using graders, backhoes and bulldozers. Topsoil and associated seed stores would be stripped from the work area and stored separately from other stockpiled soil, for subsequent use in rehabilitation. Topsoil would be stored on either side of the corridor, away from fence lines, tracks, stock routes and existing or constructed drainage.

Trenching

A trench would be dug, into which the pipe would be installed. The trench would be prepared using excavators, trenching machines, rock saws or by drilling and blasting as required by the nature of the ground. The length of open trench would be kept to the minimum necessary to allow for the pipe to be efficiently installed. Under good trenching conditions, the open trench will be exposed for a distance of approximately 40 km. In more difficult trenching conditions, this is likely to extend to approximately 60 km. Typically the trench would be open for approximately three weeks while pipe installation occurs. Wherever the trench is easily accessible to the public, it would be clearly marked by bunting and hazard lights. Breaks in the trench would be left to facilitate stock and wildlife crossing and methods would be adopted to prevent fauna entrapment. The approximate top of pipe depth in most areas would be 750 mm, and 1,200 mm or greater under waterways, rail and road crossings.

Blasting

Where ground conditions consist of consolidated rock or difficult topography, blasting would be used to assist trench construction. Blasting would utilise explosive charges to break up rock. One area that may require blasting is in the Mitchell Ranges from approximately KP430 - 450. However, other areas may be identified during the pre-construction focussed geotechnical survey. Shallow depth rock fracture would be carried out in accordance with AS2187.2.

Stringing

The 17.6 m (minimum average) long coated pipe lengths would be transported to the construction corridor from the stockpile areas at Katherine and Gove, on extendable pipe trucks. All pipe transport will be in accordance with the Transport Management Plan (Appendix O). A road safety audit and road maintenance plan will be discussed and agreed with NT Department of Infrastructure and Construction.

The pipes would be placed parallel to the trench and on wooden skids, using a vacuum lift arm on an excavator. The pipe coating would be protected by hessian bags filled with sand to act as a cushion.

Welding

Pipe lengths would be welded together on site prior to placement in the trench. Only qualified welders would be used for this operation to ensure weld quality. Strung pipes would be positioned using sidebooms and line up clamps, and welded together. Appropriate levels of non-destructive testing (generally x-ray) would be implemented, consistent with AS2885.

The welding is the most critical component of pipeline installation activities and it is crucial that the preparation work is sufficiently ahead of the welding crew, to allow a four-week continuous welding period without catching up with the stringing crew.

Coating

Following welding, joint coatings would be applied to the joints to prevent the pipeline from corroding. The weld joints would be grit blasted and coated using a suitable field coating system which is compatible with the factory applied coating system. The coating quality would be checked against strict acceptance criteria.

Bedding and padding

To ensure that sharp stones or rocky protrusions in the bottom of the trench do not damage the pipeline coating, the trench will be 'padded' with sand or fine soil to a depth of around 150 mm. Padding machines will screen the trench spoil to produce fine soil. In heavy rock areas it may be necessary to import sand from existing quarries or approved new borrow pits (identified in accordance with the Site Selection Protocol at Appendix U).

An assistive method where padding and shading material is in limited supply is to support the pipe on blocks at regular spacing along the trench bottom, and then pad and fill the trench in one operation by letting the fine material flow around the pipe to fill up the space between the pipe and the trench floor. The requirement for this method will be determined during detailed design.

Pipe bending

The pipeline would cross over crests and sharp changes in horizontal direction. To accomplish this, a specialised hydraulic pipe-bending machine would be used to bend some of the pipes to the shape required. For severe bends, factory induction bends would be used.

Pipeline lowering

The pipe would be lowered into the trench using a series of side-booms. The side-booms would raise a section of pipe off the skids and lower it into the centre of the trench. Careful handling would be required during this operation to ensure that the external coatings are not damaged during the lowering-in process.

Continuous coating tests would be carried out to ensure that any coating damage to the pipeline is detected and repaired prior to the pipeline being lowered into the trench.

Negative buoyancy measures such as weight coating would be applied to the pipeline where the final pipeline design dictates.

Where the pipeline is installed along a steep grade it would be necessary to install trench breakers to avoid erosion of the trench. Either stabilised sandbags or urethane foam sprayed *in situ* may be used for the construction of the trench breakers.

Backfilling

Following the lowering of the pipeline string into the trench, backfilling would commence. To ensure that the coating is not damaged by coarse materials and rocks, a fine material would be placed on top of the pipe to act as 'shading'. As described in the *Bedding and Padding* section, an assistive method where padding materials are in limited supply is allow the fine material to flow around, and on top of, the pipe. The requirement for this method will be determined during detailed design.

In areas where additional protection is required, under AS2885, marker tape would be installed above the pipe prior to backfill.

The trench would then be backfilled in the reverse order to which it was excavated, using the stockpiled soil adjacent to the trench. The trench would be compacted using a rubber-tyred grader. Where the pipeline passes through solid rock it may be necessary to import material for backfilling however trenching spoil would be used wherever possible. If additional material is required it would be sourced from borrow pits. At points where hydrotesting is to occur, approximately 50 m of trench would be left open until testing has been completed.

Tie-in

At regular intervals along the pipeline route, generally no more than one kilometre, it would be necessary to weld the pipeline sections that have been lowered into the trench together. The tie-in locations would also be at road, river and rail crossings and would be installed before the remainder of the pipeline by a separate crew. Welds would be tested and coating applied as described above. As the construction progresses, the first section of the corridor would undergo reinstatement at the same time as the installation of the later sections. By this time, the installation of the main line valve facilities would have commenced, as well as special road, rail and watercourse crossings, and the full construction spread would be operational. All the necessary catering, maintenance, administrative and project management personnel would be on site and the workforce for that construction spread would have reached its peak. Project personnel would also have been in the field before, during and after the construction period, liaising with landowners.

2.6.2 Workforce and construction spreads

Depending on statutory approvals and weather conditions, construction would be undertaken between November 2013 and December 2014 with the majority of construction activities ramping up in March 2014 and peaking between July and August. The pipeline would be constructed in two sections or 'construction spreads'. A construction spread refers to the equipment and crew required to build one section of pipeline.

The construction spreads are as follows:

- West construction spread: KP0-KP363 (Goyder River).
- East construction spread: KP363-KP592.
- Gove refinery: KP592-KP603.

The two spreads would be operating concurrently due to the length of the pipeline and to avoid substantial impacts associated with the wet season. Up to 780 people may be employed at any one time (with personnel generally evenly distributed across both spreads). A small construction team of approximately 40 people will construct the final 11 kilometres into and through the Gove refinery and Let-Down Station.

The construction roster is likely to be a 28 day work cycle followed by nine days rest, on a fly in – fly out basis. The construction workforce would fly in and out of Katherine and Gove Airports. A range of potential shift change timings have been considered, ranging from all of the construction staff leaving simultaneously to progressive and staggered shift changes. Each working day would comprise a 12 hour shift during daylight hours.

The pipeline installation activities are staggered and therefore not all the work crews would be needed at any one time. The workforce numbers would ramp up over a four week 'mobilisation' period. Similarly, the workforce would wind down during the 'demobilisation' period. Ideally, it is expected that the construction resources would be suitable to allow each crew to undertake their component of the construction process at a rate of approximately three to five kilometres per day.

Pegging of the ROW would occur just prior to the clear and grade activity in the second quarter of 2014. Immediately following this activity, the pipeline centreline would be pegged.

The fencing crew would be the first to travel on the construction corridor, cutting fences that cross the corridor and installing temporary fences. This crew would also comprise the surveyors who would install markers to denote the corridor boundaries. At the same time, crews responsible for preparation of the first campsite, the upgrading of the access tracks and installation of traffic controls would commence.

The corridor would then be cleared of trees and shrubs using a bulldozer, the vegetation stockpiled, and the trench strip graded, to provide a relatively flat surface for the trenching machines to operate on.

Once the corridor has been cleared and graded for a sufficient distance to ensure the trenching would not catch up, surveyors would mark the trench centreline and trenching would commence. Pipe stringing and bending would follow. Once sufficient pipe has been strung and bent, the welding, non-destructive testing (NDT) and coating crews would commence.

The order of the work may change, depending on overall logistics and ground conditions. For example, special crossing crews including HDD, boring and watercourse open-cut crossings may be dispatched prior to main line construction. In this way, the crossings would be completed and ready for tie-in when the main line welding crew reaches them. Some plant and equipment may also be used between crews, such as clear and grade plant being relocated to reinstatement (see Section 2.6.12 describing rehabilitation). However, in general, as the crews complete their activities, they would demobilise from the field.

For any given section of the ROW under construction, some level of construction activity is likely to occur over a period of at least 90 days and at times longer.

2.6.3 Accommodation

It is proposed that the majority of construction personnel would be accommodated in purpose-built, mobile construction camps strategically located along the pipeline route. The exception to this is likely to be the use of Katherine and Gove as a base for small numbers of personnel associated with construction and commissioning operations that are remote from construction camps.

Five construction camps would be required along the length of the pipeline corridor. The western construction spread would require three construction camps and the eastern construction spread would require two camps. Up to 390 personnel would be accommodated in a single construction camp. All five camps would operate simultaneously for the majority of the construction activities and be sequentially demobilised

All construction camps would have the same footprint of 500 m by 500 m. Camps would be installed progressively, each with central kitchen and dining. Some accommodation units would be progressively moved forward as construction proceeds.

Each construction camp would consist of approximately 120 transportable buildings and ancillary services for water storage, power generation, communications and maintenance facilities. Each camp would typically consist of:

- Accommodation units.
- Messing facilities (dining, canteen).
- Toilet and shower facilities.
- Laundry facilities.
- Entertainment facilities.
- Workshop and stores.
- Power generation facilities.
- Recreational facilities.
- Warehouse and laydown areas.
- Water storage tanks.
- Water treatment facility.
- Package sewage treatment system.
- Engineering and administration offices.
- Temporary internal roads and car parking.

A vehicle washdown facility may also be installed at each camp for vehicle maintenance and cleaning or for preventing the spread of weeds along the corridor during construction. Similarly, washdown facilities along the construction corridor are likely to be required and may include water spray, brush or air blown facilities. The selection criteria for the camp locations will include:

- Logistics of pipeline construction.
- Statutory and landowner approvals.
- Distance from dwellings or stock (to minimise noise, dust and visual aspects).
- Suitable terrain i.e. flat, good drainage and not adjacent to watercourses.
- Ease of access i.e. location of camps near major roads where possible.
- Environmental constraints (including avoidance of habitats for listed threatened or migratory species).
- Availability of water.

Proposed camp locations would ideally be adjacent to main roads near the following KPs (Figure 2-4):

- Beswick Camp – KP72.
- Mainoru Camp – KP193.
- Annie Creek Camp – KP295.
- Buckingham Camp – KP447.
- Wonga Creek Camp – KP548.

Specific siting of construction camps at these locations would be determined using the Site Selection Protocol at Appendix U. Existing cleared or degraded areas would be used as far as practicable but additional clearing for construction may be required.

To minimise travelling time, camps within a construction spread would be located no greater than approximately 120 km apart and would generally be shorter. This distance would generally ensure that workers do not have to travel significant distances to get to the work site, reducing the potential for safety hazards.

During the construction period, it is expected that there would be three stages of camp transportation: mobilisation at the start; relocation during construction; and demobilisation of all facilities at the end of the construction period.

It is expected that camps would need to be moved at least once during construction to minimise travelling time for the workforce. Camps 1 and 5 would be established first and all camps will have concurrent cores but transportation of accommodation units will still occur.

Camp accommodation movements along the corridor are listed below:

- Spread one (Camps 1, 2 and 3) - initial camp accommodation units near KP72, relocated to KP193 and KP295.
- Spread two (Camps 4 and 5) - initial camp accommodation units near KP447 (Buckingham Camp) and relocated to KP548 (Wonga Creek Camp).

2.6.4 Transportation

The source of the pipeline would be determined during detailed design and would be transported along with other construction materials and equipment to the site using existing port and road networks. Storage yards at Gove, Camp 1, Darwin, and potentially Katherine would be used to store the line pipe prior to construction.

The main construction items requiring transportation include:

- Line pipe.
- Construction plant and equipment.
- Diesel and other fuels.
- Compressor station and scraper station components.
- Main line valves and other facilities required at the Gove Gate Station.
- Construction camps and consumables.
- Workshops and equipment for maintaining camp facilities and plant.
- Wooden skids, coating materials and fencing materials.
- Construction materials and other miscellaneous items.

The approximate tonnage of equipment to be transported to site during construction has been calculated using standard pipeline data and is shown in Table 2-5.

Table 2-5: Approximate tonnage of equipment transported to site per spread

ITEM	APPROXIMATE TONNAGE (T)
Line pipe for 300* km	23,250
Construction plant	8,400
Diesel and fuels	3,500
Valves/facilities	1,280
Workshops	950
Camps and facilities	900
Consumables	75
Minor construction materials	600
Miscellaneous	1,000
Total for one spread	**40,000**

*360 km: Spread 1
240 km: Spread 2

Line pipe

The line pipe would be sourced from a pipe mill with suitable capacity and the external corrosion coating applied at a separate pipe coating mill. The line pipe would be delivered to the Northern Territory by sea, as there is no pipe mill in Australia capable of manufacturing the line pipe. Pipe for the western construction spread would be delivered to Darwin Port, stockpiled and transported by road to Katherine/Camp pipe stockpile. Pipe for the eastern construction spread would be delivered to Gove Port where it would be stockpiled for subsequent delivery to the construction corridor by road.

Small stockpiles of pipe (up to 10 km) may be required at various points along the corridor to offset transport delays. Stockpiles would be located either at campsites or at other locations in close proximity to the corridor, in agreement with relevant landowners.

Assuming the line pipe is manufactured in triple random lengths (minimum average 17.6 m) this equates to approximately 34,262 lengths of line pipe or 1,760 pipe trailer truck trips to move the line pipe (1,000 from Katherine and 760 from Gove). The estimates are based on a fully laden truck with a single extendable trailer (18 m) on the outward trip and an empty truck on the return trip. The Western spread (Katherine end) is expected to have approximately 60% of these movements, while the Eastern spread (Gove end) is expected to have approximately 40% of these movements. If a two trailer configuration is permitted by the NT Government (upon application) and used, the number of trips by pipe trucks would reduce by around 50%. Transport and traffic considerations are discussed further in Chapter 14.

Construction plant and equipment

The construction contractor would be responsible for providing the construction plant and equipment. Accordingly, the equipment may be transported interstate by rail or road, or from overseas, most likely into the port at Darwin or Gove. The origin of the equipment would be determined by the contracting company during detailed design.

Typical plant and equipment to be transported to site includes:

- Bull dozers, loaders and graders.
- Sideboom tractors and forklifts.
- Trucks (water, fuel, mechanics) and trailer units.
- Trenching and padding machines.
- Welding rigs.
- Excavators, rock saws and wheel ditching machines.
- Semi-trailers and low loaders (for equipment relocation).
- Mobile cranes.
- Camp buildings.

More detailed information relating to camp movements, fuel supply and road upgrades and maintenance is provided in Chapter 14.

2.6.5 Construction of crossings

Although the requirement for crossings has been avoided where possible, the proposed route would require the pipeline to cross several watercourses, roads and infrastructure corridors. Specialised techniques for installing the pipeline would be employed at crossing locations. The approach to construction at these crossings would reflect environmental and cultural sensitivities to avoid/minimise impacts to these areas, whilst providing the best technical solution. In most cases construction of crossings would require additional minor areas of temporary access outside the 30 m ROW. Open cut, HDD and horizontal boring would be the preferred construction methods to be used for crossings.

As part of the crossing selection process, the following requirements would be incorporated into the pipeline design:

- All crossings (rail, highway, sealed road and river) would be constructed using open cut trenching, HDD or horizontal boring.
- Concrete slabs would protect the pipeline where it crosses under table drains adjacent to roads.
- The design for major road, highways and railway crossings would cover the full width of the rail or road reserve whilst the depth will be consistent. The rail crossing method would be by bore for the full length. Road crossings would typically only bore the crown, while the remainder of the reserve would be trenched.
- All pipeline wall thickness would have sufficient strength to resist external loads under worst case conditions.
- Buoyancy control would be applied at river crossings where the design dictates.
- All crossing designs would be implemented in accordance with any relevant agreements with land owners.
- Crossings would be designed as per AS2885.1.

Road and infrastructure crossings

Sealed road crossings are proposed to be horizontally bored using an auger. Waste material from horizontal boring would be stockpiled, and re-used as a source of fill for other pipeline sections if appropriate, or otherwise disposed of in accordance with regulatory requirements or at a licenced facility. In addition to the sealed roads, it is proposed that the Melville Bay Road on Special Mineral Lease 11 at Gove Operations would be horizontally bored.

All unsealed road crossings are proposed to be by open-cut method, subject to the approval of the relevant road authority. A trench would be excavated in a similar fashion to that employed for standard trenching. The welded pipe is placed in the trench and the excavated material returned. The disturbed area is then reinstated. Vehicle access would be maintained across the trench by the use of bypasses or steel plates. Trenches would remain open for the shortest possible time period to minimise impacts on traffic. All road surfaces would be returned to a standard equal to that prior to construction. Appropriate signage and other traffic control measures would be employed to ensure safety at all times.

Depending on tie-in location to the Amadeus Gas Pipeline, the Alice Springs–Darwin rail line crossing is the only potential rail crossing. This crossing if required is proposed to be horizontally bored.

Watercourse crossings

During the early project design phase, watercourse crossings played a key role (together with other environmental, social, economic and technical aspects) in determining the most appropriate route for the KGGP. Major revisions were made to the preferred route in order to avoid areas of environmental or cultural sensitivities and to provide the best engineering option. Minor refinements to the pipeline corridor and locations of watercourse crossings were also made to avoid environmentally and culturally sensitive areas.

The method used at each watercourse crossing would be dependent on environmental factors, geotechnical constraints and stakeholder views in regards to the significance of the watercourse. Horizontal Directional Drilling (HDD) and open-cut and are the preferred construction methods.

HDD involves drilling a hole into the ground at one side of the crossing at a 10–15^{o} angle, drilling a curved hole with the drill surfacing on the other side of the crossing (Figure 2-5). The hole acts like a tunnel through which the pipeline is threaded. Drilling is conducted by a specially designed drill rig and operated by a specialist contractor. This technique usually results in a stockpile or tanks of saturated cuttings and drilling mud displaced from the hole. This material would be spread across the pipeline ROW to dry naturally where it then forms part of the reinstatement.

The entry and exit pit of the HDD would be set to avoid riparian vegetation, to account for the profile of the watercourse and so as to not be damaged in flooding events. The setback distances of the entry and exit pits are assessed on-site for each water course to meet above criteria.

Where the pipeline ROW is straight and aligned on each side of the crossing, HDD activity will be confined to the 30 m ROW. If the ROW makes a turn on one side of the crossing or is not aligned at the crossing then an additional area of land approximately 10 m wide on one side of the crossing is required so that the straight pipe string stays aligned with the HDD drill path and construction can be completed (Figure 2-6).

The HDD method would be preferred where the long term stability of the crossing is of concern or for ecological reasons, particularly to protect significant riparian vegetation or conservation values. HDD would also be used at any watercourse that is determined to be in flow by the construction contractor at the time of constructing the crossing. Minor flows at the time of construction would not necessitate HDD.

Confirmation of crossings requiring HDD is the subject of further consideration during the engineering, design and construction phases. However, nine watercourses have been identified as potentially requiring to be crossed by HDD for ecological and engineering reasons and are listed in Table 2-6 with their location along the pipeline and justification for HDD.

Table 2-6: Indicative Horizontal Directional Drilled (HDD) river crossings

WATERCOURSE	KP	JUSTIFICATION FOR SELECTION
King River	29.5	Deep and wide river channel with steep banks which could be difficult to stabilise and rehabilitate.
Waterhouse River	83.7	Riparian vegetation and in-stream habitat of conservation significance – potential for significant impacts if construction machinery is transported across multiple braided channels.
Mainoru River	209.5	Riparian vegetation and in-stream habitat of conservation significance – potential for significant impacts if construction machinery is transported across multiple braided channels.
Wilton River	259.5	Riparian vegetation of conservation significance. Deep river channel with steep banks – specific attention is required to stabilise and rehabilitate. Note that access road across the river, adjacent to proposed pipeline alignment, would be used to transport equipment across river.
Goyder River	360.5	Riparian vegetation and in-stream habitats of conservation significance - potential for significant impacts if construction machinery is transported across multiple braided channels. Deep river channel with steep banks – specific attention is required to stabilise and rehabilitate.
Boggy Creek	511.5	Riparian vegetation and in-stream habitats of conservation significance. Deep river channel. Potential for impacts on hydrology of waterhole which has a small outflow.
Cato River	539.7	Riparian vegetation and in-stream habitats of conservation significance.
Giddy River	571.7	Riparian vegetation and in-stream habitats of conservation significance – potential for significant impacts on the vegetation island in the river channel. Banks require specific attention to stabilise and rehabilitate.
Latram River	581.0	Known habitat of *Pternandra coerulescens,* a plant species listed as Vulnerable under NT legislation. High level of recreational use as a waterway. Riparian vegetation and in-stream habitat of conservation significance.

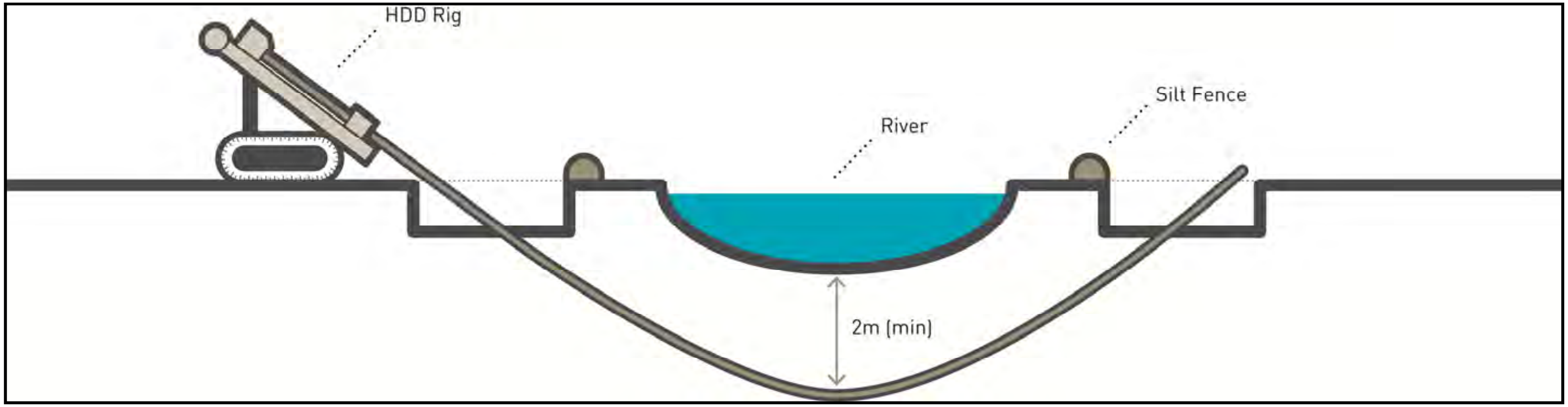

Figure 2-5: Horizontal Directional Drilling

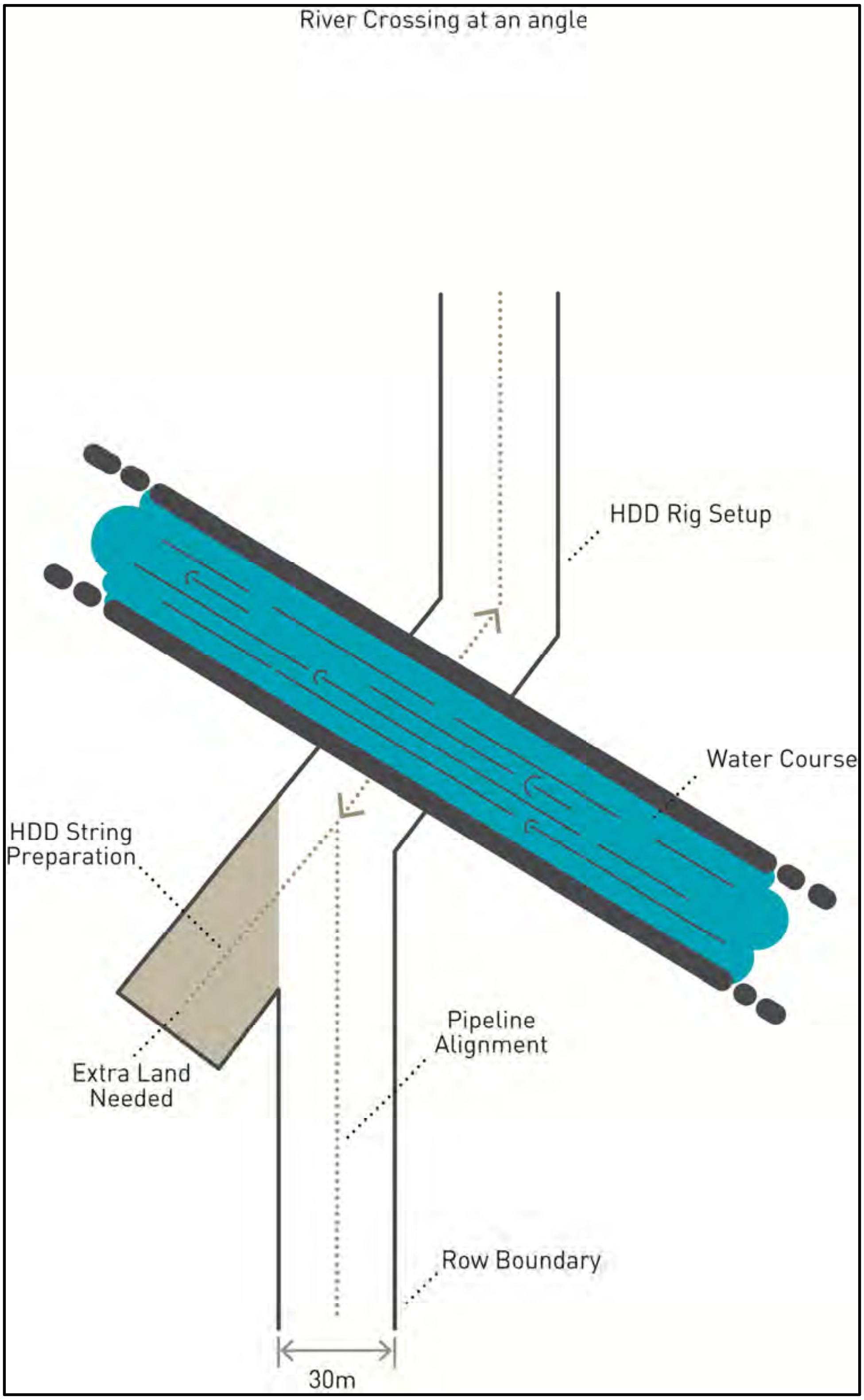

Figure 2-6: Additional working area for HDD where crossing is angled

In the event that unforeseen geotechnical considerations preclude HDD for a crossing at a watercourse that is in flow or identified in Table 2-6, alternative open cut trenching techniques would be employed that temporarily divert flow around the work area while ensuring minimal hydrological impact. Stream flow would be maintained by use of flume pipes or partial weirs. Silt fencing would be installed where required to reduce silt movement beyond the excavation and to contain stockpiled spoil. It is however, considered very unlikely that such techniques would be required.

Open cut crossing of watercourses would be the preferred method for any watercourse that is not in flow, as determined by the construction contractor at the time of constructing the crossing. Open cut crossings would involve the excavation of a trench in a similar fashion to that employed for standard trenching. For some larger watercourses the standard ROW will need to be increased to 50 m wide in the 50 m lead up to each bank. The ROW would be reduced from the standard 30 m width within the watercourse crossing. The welded pipe is placed in the trench and the excavated material returned. The disturbed area is then reinstated. The pipeline trench would be excavated so that the minimum cover above the pipeline to the riverbed is 1,500–2,000 mm depending on the size of the river. Pipe bends required to profile the pipeline into and out of the river would generally be formed on site. Following pipeline laying the trench would be backfilled, initially with a 150 mm sand surround, followed by coarse silt free material or, depending on quality, the excavated material. Loose rocks or ‘rip-rap’ may be placed on the banks or in the stream to reduce the risk of erosion and seeding and seed mats would be placed along the slopes, if required. The cross sectional profile of watercourses subject to trenching would be reinstated to preconstruction condition.

2.6.6 Communications, power generation and water supply

Communications

High frequency communication systems are proposed along the construction corridor for voice radio coverage during construction. Satellite communication systems would also be used.

Power generation

Diesel generators would be used to supply electricity to the construction camps.

The compressor station would be powered by gas turbines, driven by fuel offtake gas obtained from the KGGP. The use of this gas would be metered and monitored. The compressor station would be designed to have an initial installed power requirement in the order of 4.5 MW.

Water supply

During construction, water would be required for activities such as dust suppression, HDD, hydrotest and camp supplies. The estimated total volume of water required for the project is approximately 207 ML. Water would be sourced from either surface or groundwater resources or a combination of both. If potable water cannot be sourced as described above it would be trucked in from Katherine or Gove. A Water Supply and Adaptive Management Strategy is discussed in Chapter 7.

2.6.7 Hydrostatic testing

Testing of a pipeline and ancillary components is an integral part of pipeline construction. Testing would generally take the following forms:

- Testing materials prior to construction.
- Testing of welds.
- Hydrostatic testing.

The manufacturers of materials and equipment would carry out quality assurance tests during manufacture of all items. Any items that fail the quality test would be marked and quarantined to ensure they are not used as part of the KGGP.

All welds would be checked in accordance with strict industry standards. Testing of welds would be carried out using x-ray techniques.

Hydrostatic testing would be used to determine the strength and leak tightness of a test section to establish that a pipeline is capable of withstanding the pressure for which it is designed and for leak tightness.

During hydrostatic testing the pipeline would be filled with water, pressurised to greater than normal operating pressure and then leak tested. It is proposed that the pipeline be tested in 11 test sections, averaging 55 km. The longest test section expected would be approximately 100 km. The finalised section lengths would depend on the land profile and would be determined by the project hydrotest engineer. Test sections would be governed by criteria including: elevation; construction logistics; geographic features; and availability of water.

Where required, hydrotest water would be stored in a 'turkeys nest' (dam). The water would be tested prior to use to confirm the need for chemical treatment and the required chemical dosing rates. The addition of biocides and oxygen scavengers to the hydrotest water could be required to prevent corrosion of the pipeline. The exact methodology for hydrostatic testing would depend on water availability but may include transferring water from one section of the pipe to another to minimise the overall volume of water used. Small volumes of water (generally less than 5 ML) could be transferred from one catchment to another.

Following completion of the hydrostatic testing, 'dewatering' of the pipeline would be necessary. Disposal of hydrotest water would be in accordance with Australian Pipeline Industry Association (APIA) Code of Environmental Practice and is discussed further in Chapter 7.

Following dewatering, pigs would be propelled through the pipe using compressed air to sweep appreciable quantities of water and debris such as weld slag and dust from the pipeline. To prevent an increase in corrosion potential or hydrate formation, once dewatering is complete, the pipeline would be dried using an air compressor fitted with dehydration equipment. The sequence of pigs sent through the line would be a combination of bi-directional and hard foam pigs. Pigging would stop when pigs exit the line relatively dry. Medium density foams pigs and softer swab foam pigs would then be sent through the line. This combination would be continued until a number of criteria are satisfied, including that of the final pig run, using a new swab pig. These include:

- The air that is purged in front of the pig as it exits the pipe is clear.
- The line contains no freestanding water, i.e. the swab pig exits the line with no visible wet patches.
- The air emerging from the pipe has a dew point of not more than –20°C (measured using a handheld tool near the pipe exit).
- Dust has not penetrated the swab pig to more than a pre-determined depth.

A repeat test would be carried out after a 24 hour hold period to confirm the –20°C dew point.

In the unlikely event that a leak is detected during hydrotest, the options for repair would be:

- Dewater the section of pipeline, repair the pipe and retest the section. The repair may be located along the pipe section such that partial dewatering would allow dry access to the repair site, for example, at the top of a rise.
- Freeze the pipe section over the repair site, by using liquid nitrogen to form a plug of ice inside the pipe. The repair can then be carried out, the frozen section thawed, and the section retested. In this case, strict safety procedures would apply, including the use of a specialised contractor and the implementation of a specific Safety Management Plan and Job Hazard Analysis (JHA), or equivalent, for the activity prior to any work commencing.
- Replace the damaged section of pipe should the leak be found to have occurred from damage to the pipe section or from fault at manufacture.

2.6.8 Lighting

Generally there would be no requirement for the work area around the pipeline ROW to be lit at night as construction activity is anticipated to take place between the hours of 6 am and 6 pm. The following aspects of the project construction could require some night work using lighting:

- Designated areas necessary for public safety.
- Hydrotesting.
- HDD of river crossings.
- Trenching (if construction needs to be accelerated).

Areas to be lit at night to allow night access would include:

- Camps.
- Gen-sets.
- Machinery maintenance areas.

2.6.9 Access

During construction, access would be required along the construction corridor and to the campsites, pipe stockpiles, water bores and borrow pits. The majority of heavy equipment would be transported along existing roads, which are generally sealed or gravel, however maintenance would be required in particular areas to ensure that sections of roads, bridges and grids are capable of carrying the loads of pipe trucks and heavy equipment floats.

Although the Central Arnhem Road often parallels the proposed pipeline corridor, in many sections there is a distance of up to 25 km between the road and the corridor. New access tracks would be constructed between the roads and the corridor to minimise the movement of heavy traffic and to allow permanent access for operational personnel once the pipeline is constructed.

Additional access tracks may be required to access local water bores and watercourses supplying water for dust suppression, potable use and for hydrotesting. These access tracks would be identified in detail following an investigation into water source options.

The location of access tracks would be determined during the design phase and the process set out below would be used to locate the tracks and ensure appropriate environmental aspects are considered.

Prior to construction of access tracks, Pacific Aluminium will conduct flora, fauna and heritage evaluations of areas through which these tracks will be placed, including desktop study and targeted pre-clearing inspections ahead of construction, to identify the following areas or features requiring consideration in management of construction:

- Areas or features of high conservation significance
    - Vegetation representative of the Arnhem Plateau Sandstone Shrubland Threatened Ecological Community (TEC).
    - Known, likely or potential critical, regionally significant and/or locally restricted habitat for threatened and/or migratory species listed under Territory or Commonwealth legislation.
    - Sites of archaeological or cultural heritage significance.
- Other areas requiring consideration for environmental management
    - Sensitive habitat such as wetlands, monsoonal rainforest, melaleuca forest, or riparian vegetation.
    - Major weed infestations.
    - Sites of Yellow Crazy Ant infestation.
    - Highly erodible soils.
    - Flood prone areas.

Within six months of completion of construction, Pacific Aluminium will submit a Final Access Road Alignment Summary Report to the NT Government and SEWPaC demonstrating how the access tracks/roads were designed and constructed to:

- Avoid direct disturbance of areas or features of high conservation significance.
- Avoid, unless not reasonably practicable, and take into account other areas requiring consideration for environmental management.

The Summary Report will indicate those access roads, or parts thereof, that were temporary and how these have been, or are in process of being, rehabilitated following construction.

2.6.10 Fire management

A Fire Management Plan would be prepared to address bushfire prevention and management during construction and maintenance of the KGGP, including training. This Plan would detail all aspects of risk reduction, management and planning including the coordination of weed and fire management activities, workforce inductions and the use of skilled personnel in all aspects of fire management. A Provisional Fire Management Plan is provided at Appendix O.

2.6.11 Rehabilitation

Rehabilitation of disturbed areas would be undertaken as soon as possible following construction, during the work season and prior to the onset of the wet season. Actions would be consistent with the Provisional Rehabilitation Plan contained in the EMP (Appendix O). The intended outcome of rehabilitation measures would be to ensure all areas disturbed through construction are stable and returned to a condition consistent with existing land use.

Table 2-7 summarises the anticipated native vegetation clearing required to facilitate construction of the project, and the proportion of native vegetation in disturbed areas likely to return to pre-disturbance condition.

Table 2-7: Disturbance area of the project

ACTIVITY	COMPONENTS INCLUDED	LIKELY DEVELOPMENT FOOTPRINT	LIKELY AREA (PROPORTION) TO RETURN TO NATIVE WOODY VEGETATION
KGGP ROW	• Clearing 30 m wide for the length of the pipeline • Turning bays • Additional ROW working width at water crossings	1,850 ha	1,110 ha (60%)
Ancillary infrastructure	• Stockpiles • Compressor station • Mainline valves • Scraper stations • Anode beds • Meter station • Construction camps	180 ha	170 ha (94%)
Construction access	• Access tracks (110-150 km) • Borrow pits	140 – 170 ha	70 – 85 ha (50%)
TOTAL		**up to 2,200 ha**	**up to 1,365 ha**

Clean-up and rehabilitation measures would be applied to the pipeline corridor, access tracks and camp sites in consultation with the relevant land holder/owner following construction. Rehabilitation actions would depend on site specific considerations (see the Provisional Rehabilitation Plan) but would generally include:

- Removal of construction and material waste.
- Surface contouring.
- Re-spreading topsoil.
- Re-spreading cleared vegetation.
- Re-seeding of grass species.
- Replanting vegetation in areas of high sensitivity (e.g. riparian zones or for landform stability)

To provide initial stability to the reinstated landform, reduce weed ingress and encourage regrowth of native vegetation, disturbed areas where risk factors or landholder considerations are relevant would be re-seeded with suitable native grass species before the onset of the first wet season.

Trench breakers, contour benching and berms or water breaks with velocity stops or rock protection, as required, will be utilised for erosion control.

In certain areas of the pipeline corridor, a low 'formed camber' of material may be allowed to remain over the trench line to allow for possible subsidence. The formed camber would be broken at regular intervals to prevent disruption to surface water flows.

Native vegetation would be allowed to regenerate naturally over disturbed areas (with the exception of the vehicle access track). However, deep rooted trees would not be allowed to re-establish over the buried pipeline. A 30 m wide ROW would not be a barrier to natural seed fall and over the longer term it would be expected that over time, approximately 60% of the ROW would return to native woody vegetation. The remaining 40% comprises the access track and area immediately above the pipeline that would be kept free of woody vegetation. This is conceptually illustrated in Figure 2-7. Successful rehabilitation has been achieved on other recently constructed pipelines in the Northern Territory.

Provision is proposed for vehicle access along the corridor following rehabilitation however this would be restricted to a single 4WD track adjacent to the pipeline. This area would be kept free of trees and shrubs, but grass coverage would be encouraged. The track would be used for commissioning and maintenance during pipeline operations. The access track would not be drivable for the length of the pipeline route as a result of intersections with major rivers and public use would be restricted (see Chapter 14).

It is anticipated that land users would be able to resume their previous activities on top of the pipeline providing that excavation activities are not undertaken and deep rooting vegetation does not establish.

2.7 COMMISSIONING

2.7.1 Commissioning procedures

Instrumentation

All instrumentation would be checked to ensure correct calibration. These tests would be carried out in accordance with appropriate industry guidelines.

Performance testing

All valves and equipment would be tested to ensure operation to design specifications. Strict industry guidelines would be applied, particularly during the testing of emergency shut-down equipment.

All methodologies and acceptance criteria would be approved prior to carrying out any test. Where tests fall outside of the agreed acceptance criteria repair work or modifications would be carried out. Subsequently, the acceptance tests would be repeated.

Pipeline purging

During the introduction of gas, the pipeline would be purged of air. The short section where the gas mixes with air would be vented.

2.7.2 Workforce and accommodation

Commissioning activities would be coordinated by a ‘Commissioning Manager’, who would take responsibility for each system until handing over to the pipeline operator. A team of specialist commissioning staff, with extensive experience in pipeline commissioning and operation, would be employed for all commissioning activities. It is anticipated that approximately 28 people would be required specifically for the commissioning phase of the project, as summarised in Table 2-8.

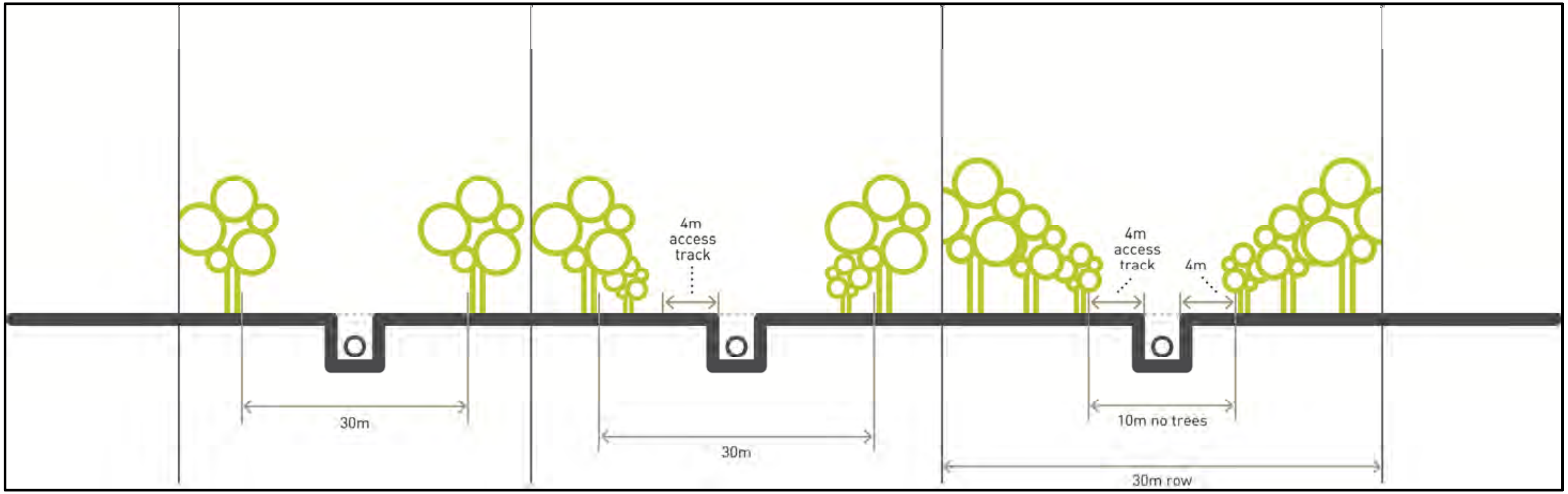

Figure 2-7: Conceptual description of rehabilitation of the ROW over time

Table 2-8: Commissioning workforce requirements

COMMISSIONING AREA	PERSONNEL REQUIRED
Supervisory Control and Data Acquisition (SCADA)	4
Communications	4
Facilities	4
Electrical and instrumentation	4
Pipeline	10
Cathodic protection	2
Total	**28**

The commissioning team would be accommodated in a mobile camp, or in nearby towns where possible.

2.7.3 Access

During commissioning activities some light vehicles are required such as small trucks to move the pigs and 4WDs to carry personnel and tools. Access to the pipeline would be via existing roads, nominated access tracks, and an established access track along the construction corridor.

2.8 OPERATION

The pipeline, associated above ground facilities (main line valves and scraper stations) and compressor station would be operated and maintained in accordance with AS2885.3 and appropriate industry guidelines.

Prior to start-up, a Safety and Operating Plan (SOP) would be prepared for the pipeline as required under AS2885.3. This plan would be the overarching document that draws together the engineering and operation details. The SOP would ensure comprehensive information is available to personnel regarding operations, inspections and maintenance of all facilities. Emergency and reporting procedures would also be in place (see Chapter 16). Plans and procedures would be reviewed and updated if significant incremental change has occurred.

2.8.1 Operating systems

A maintenance and operations base would be located near Katherine for central access to the pipeline and all facilities. All remote controlled functions would be directed from a centralised control room via a SCADA system. This system would monitor operating parameters, equipment status and malfunction alarms at the remote facilities via specialised instrumentation and would present them to the operator via colour graphic displays.

Personnel responsible for operation and maintenance of the pipeline, above ground facilities and compressor station would be trained and experienced in all aspects of the equipment in their control.

2.8.2 Inspection and maintenance

Once installed, inspection and maintenance programmes would be established to monitor the pipeline's integrity and ensure that the public and property along the route are adequately protected during operation. The inspection and maintenance programme would be carried out by approved and appropriately trained personnel and would include the pipeline, all above ground facilities, compressor stations and the cathodic protection system. The consent to operate for the pipeline, incorporating the Northern Territory statutory requirements, would define the frequency of inspections at the MLVs, scraper stations and along the corridor, as well as the frequency of pigging.

Inspections

Inspections would be carried out along the ROW at scheduled intervals under AS2885 requirements throughout the life of the pipeline. Inspections would focus on checking the integrity of the pipeline and identifying any new or changed threats to the pipeline. Inspections may be carried by helicopter or light plane.

Inspections will be at least annually and more frequent during the initial period following construction to confirm the stability of landforms. Inspections may also be carried out after heavy rainfall, or other significant events. More frequent monitoring may be scheduled for major creek crossings or sections with a known risk of erosion or flooding. The surveillance criteria would include, but not be limited to the following:

- Variations to surface conditions (for example erosion, trench subsidence or earth movement).
- Indication of leaks such as dead vegetation.
- Establishment of deep rooted vegetation in close proximity to the pipeline or weed infestation.
- Evidence of pipeline exposure.
- Construction activity or evidence of impending construction activity on or near the pipeline route.
- Impediments to the access of the route.
- Deterioration of the pipeline markers.
- Security of the site and evidence of unauthorised entry.

Maintenance of the corridor would be an ongoing requirement for the life of the project, to address any erosion, subsidence or weed infestation, but is likely to be less frequent after the first couple of years of operation.

Post-commissioning coating survey

A one-off coating survey would be carried out within 12 months of construction completion. If a coating defect is detected, depending on the estimated size, the line may be exposed and the coating repaired.

Corrosion detection

Internal inspection of the pipeline would focus on detection of corrosion, and would be carried out by an intelligent pig capable of inspecting the full circumference and length of the pipeline. Inspections using the intelligent pig are typically carried out once every five years or in accordance with the conditions of the pipeline licence.

Cathodic protection systems

The cathodic protection system would be checked at regular intervals to ensure that the protection voltages are within limits and to monitor any likely areas of corrosion.

Testing points would be located at intervals of between two and five kilometres along the pipeline. These testing points would allow for the measurement of structure-to-electrolyte potentials, using a high input impedance voltmeter and half-cell. Adjustments would be made to the cathodic protection current output to ensure that the protective potential is maintained at a sufficient level. Testing would occur every six to twelve months.

Maintenance

Routine maintenance activities would occur at the MLVs, scraper stations or compressor station located along the main pipeline route. To allow maintenance to take place a small volume of gas must be vented from the pipeline when the pig launchers and receivers are depressurised. This would occur up to twice year when cleaning pigs are deployed, and during other general maintenance activities, as required.

Watercourses found to not be maintaining stability and suffering erosion will be repaired with more robust erosion control such as rock sheeting rather than original material.

To allow repairs to the pipeline itself, the connection of new pipeline branches, or repairs to MLVs or scraper stations, the relevant section of pipeline would be isolated between the adjacent valves, and the sections vented. This is unlikely to happen at less than five yearly intervals, if at all, during the life of the pipeline. Emergency venting may also be required in the case of a compressor station emergency shut-down. Under these circumstances all gas would be vented from the station as quickly as possible to minimise the risks of fire or explosion and to minimise the duration of noise emissions. The impacts and mitigation measures associated with venting events is discussed in Chapter 12 and Appendix O.

During operation of the KGGP, supporting facilities (including the compressor station) would be unmanned. Operations and maintenance depots would be located at Katherine and Gove and approximately six maintenance/operations personnel would be required. Regular maintenance of above ground facilities and the compressor station would be carried out to ensure that the control, safety and operating systems are functioning correctly and reliably. Valves would be inspected at regular intervals to ensure that:

- Each valve is supported.
- Support points are not corroding.
- Valves are not leaking.
- Valves and actuators are fully operable.
- Valves are secured to prevent unauthorised access and usage.
- Valves are regularly tested and operated to confirm operability.

Scraper traps, also referred to as ‘pig traps’ are used to launch or receive pigs during maintenance or emergency procedures. All components of scraper traps (including end closure seals, bleed locks, electrical bonds, locking rings, pig signallers and fasteners) would be maintained at approved intervals. The traps would also be inspected to ensure that mechanical damage (due to handling) has not occurred and corrosion is not occurring.

The compressor station would require specific maintenance to ensure their safe operation, including:

- Cleaning and replacing of gas inlet filters.
- Inspection of header boxes and tubing in gas coolers.
- Checking and replacing lube oil.

A buffer zone around the compressor station would be kept free of vegetation to provide protection to the facilities in the event of a bush fire, acting as a firebreak. A tree-free zone would be maintained around the security fence where all trees would either be trimmed or removed. This is to ensure that no trees would fall and damage the security fence.

2.8.3 Workforce and accommodation

During operation/maintenance the KGGP is expected to directly employ in the order of six persons, as and when required. There would be no permanent staffing of above ground facilities along the pipeline route. A permanent staff base at Katherine would oversee operation of the compressor station and act as a maintenance base. One staff member would be based at Gove in the Gove Operations team.

2.8.4 Access

Access to the pipeline during operation would be required for inspection and maintenance activities. All access would be via approved access tracks.

The access track alongside the pipeline will not be drivable for the full length of the pipeline route as major river crossings will be impassable. Individual sections of the pipeline will be accessed via permanent access tracks. The remoteness would discourage public access and reduce the likelihood of the pipeline corridor becoming a thoroughfare. After construction of the KGGP, access along the pipeline route would not be encouraged other than for authorised routine maintenance activities.

2.8.5 Utilities and communication

Supporting infrastructure such as scraper stations and the cathodic protection system would be powered by a remote area power supply (RAPS). A RAPS system comprises solar electric panels with a battery system. Solar systems are a cleaner and cost effective alternative to using diesel generation.

RAPS would supply power to the following:

- Telemetry systems.
- Cathodic protection system.
- On-route communication systems.

Water requirements during operation would be minimal and limited to supply for potable water and ablutions at King River compressor station.

2.9 DECOMMISSIONING

The objective of decommissioning is to close down operations and remove surface structures, leaving the environment as near as practicable to its original condition. Decommissioning of the pipeline would comply with legislative requirements, relevant Australian Standards and industry practice in force at the time the KGGP project ceases, and would be conducted in consultation with landowners.

In general, decommissioning requirements are project-specific, being considered on a case-by-case basis, assessing both the environmental and commercial costs.

There are typically three options involved in the decommissioning of a pipeline. These are:

- Removal.
- Suspension.
- Left *in situ*.

Removal of the pipeline would not be environmentally preferable as it would involve excavation and considerable land disturbance. It is likely that the KGGP would remain buried (suspension or left *in situ*) at the end of the project life.

Both suspension and *in situ* options involve disconnecting the pipeline from the system. The suspension option involves filling the pipeline with an inert material, such as nitrogen, and maintaining as per an operating pipeline. The *in situ* option involves disconnecting the pipeline from the cathodic protection system and leaving the pipeline to degrade. If the *in situ* option was adopted all above ground facilities and supporting structures would be removed and these areas reinstated.

A provisional decommissioning plan is provided in Appendix O. A detailed decommissioning plan and rehabilitation programme would be developed and implemented in consultation with landowners and relevant authorities at the time of decommissioning to ensure that the area is suitably rehabilitated. The plan would address drivers, costing, and timing as well as monitoring and rehabilitation requirements for disturbed areas.