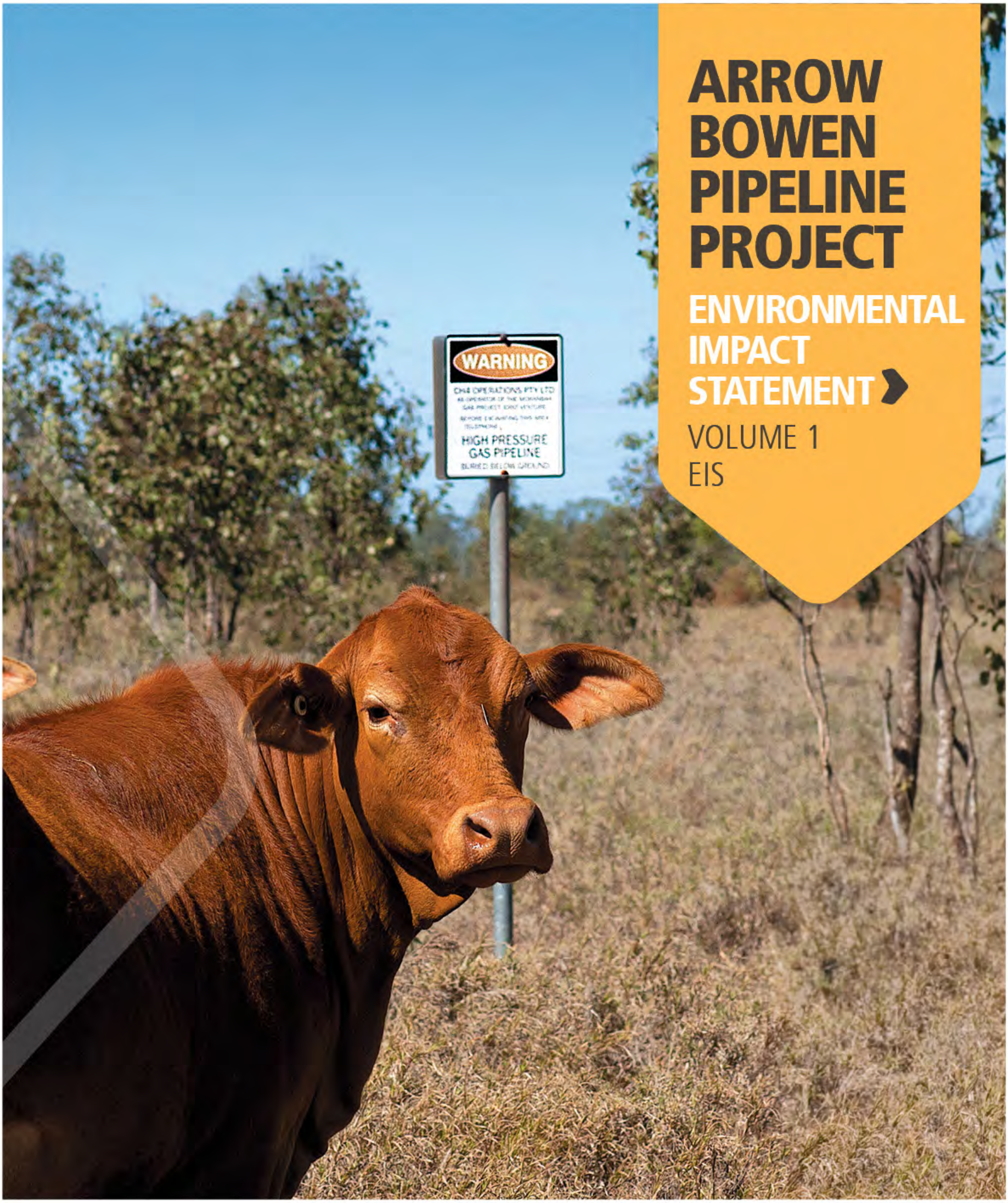
ARROW BOWEN PIPELINE PROJECT

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1

EIS



arrow energy
go further

DECEMBER 2011

GENERAL STATEMENT

RELIANCE STATEMENT

The purpose of this report and the associated services is to undertake an environmental impact assessment of the proposed Arrow Bowen Pipeline Project (the project) in accordance with the scope of services set out in the contract between Sinclair Knight Merz Pty Ltd (SKM) and Arrow Bowen Pipeline Pty Ltd (Arrow). That scope of services, as described in this report, was developed with the Client.

In preparing this report, the following documents have been relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided. These include, but are not limited to;

- Environmental Assessment Report (Flora) for the Proposed Arrow Bowen Pipeline (AECOM, 2011).
- Initial Safety Management Study (GHD, 2011).
- Arrow Bowen Pipeline Proposed Pipeline Alignment Travelogue (Coffey, 2011).
- ABP Traffic Impact Assessment (GHD, 2011).
- Water Crossing Information for the Arrow Bowen Gas Pipeline (AECOM, 2011).
- ABP Flood Impact Assessment (GHD, 2011).
- Arrow Energy Major Pipelines Water Availability Study (GHD, 2011).
- Cultural Heritage Impact Assessment Arrow Bowen Pipeline Environmental Impact Statement CQCHM, 2011).

Except as otherwise stated in the report, no attempt has been undertaken to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

The data in this report is from data available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. The report has been prepared in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Arrow or SKM for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of Arrow, and is subject to, and issued in accordance with, the provisions of the agreement between SKM and Arrow. SKM accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

Version	Purpose of Document	Orig	Review	Review Date	QA Review	Release Approval	Issue Date
Rev 0	Draft – DERM review	DW/MC	GLM	29.11.2011	CB	02.12.2011	02.12.2011
Rev 1	For public comment	GLM	MC	24.02.2012	DT	01.03.2012	01.03.2012

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation / acronym	Meaning
4WD	4-wheel drive
AADT	Average Annual Daily Traffic
AASS	Actual acid sulfate soils
AB	Arrow Bowen (mainline)
ABS	Australian Bureau of Statistics
ACH Act	*Aboriginal Cultural Heritage Act 2003*
AGL	Australian Gas Light Company
AHC Act	*Australian Heritage Council Act 2003*
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
ANZIC	Australian and New Zealand Standard Industrial Classification
APIA	Australian Pipeline Industry Association
APLNG	Australia Pacific LNG
ARI	Average recurrence interval
Arrow	Arrow Bowen Pipeline Pty Ltd
Arrow Energy	Arrow Energy Pty Ltd
AS	Australian Standard
ASP	Arrow Surat Pipeline, formerly known as Surat Gas Pipeline (SGP)
ASS	Acid sulfate soils
ATSIHP Act	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
BG	British Gas
BOM	Bureau of Meteorology
BOP	Balance of Payments
BPA	Biodiversity Planning Assessment
BRS	Bureau of Rural Sciences
CEMP	Construction Environmental Management Plan
CHIMS	Cultural Heritage Information Management System
CHMP	Cultural Heritage Management Plan
CHMS	Cultural Heritage Management Strategy
CLR	Contaminated Land Register
CO_2-e	Carbon dioxide equivalent
CO	Carbon monoxide
Coastal Act	*Coastal Protection and Management Act 1995*
CQCHM	Central Queensland Cultural Heritage Management

Abbreviation / acronym	Meaning
CQP	Central Queensland Gas Pipeline
CQSS	Central Queensland Strategy for Sustainability
CQSS2	Central Queensland Strategy for Sustainability – 2004 and Beyond
CRL	Copper Refineries Pty Ltd
CSG	Coal Seam Gas
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSMP	Construction Safety Management Plan
dB(A)	Decibel
DCCEE	Department of Climate Change and Energy Efficiency
DCDB	Digital Cadastral Data Base
DEEDI	Department of Employment, Economic Development and Innovation
DEM	Digital Elevation Model
DEO	Desired Environmental Outcome
DERM	Department of Environment and Resource Management
DFE	Defined Flood Event
DL	Dysart Lateral
DO	Dissolved oxygen
DR	District Road
DSEWPAC	Department of Sustainability, Environment, Water, Population and Communities
DTMR	Department of Transport and Main Roads
EA	Environmental Authority
EEC	Endangered Ecological Communities
EHMS	Environmental, Health and Safety Management System
EIN	Environmental Improvement Notice
EIS	Environmental Impact Statement
EL	Elphinstone Lateral
EMP	Environmental Management Plan
EMR	Environmental management register
EMS	Environmental Management System
EO	Environmental Officer
EP Act	*Environmental Protection Act 1994*
EP Regulation	*Environmental Protection Regulation 2008*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPC	Exploration Permit - Coal
EPM	Exploration Permit – Minerals

Abbreviation / acronym	Meaning
EPP	Environmental Protection Policy
EPP(Air)	*Environmental Protection (Air) Policy 2008*
EPP (Noise)	*Environmental Protection (Noise) Policy 2008*
EPP(Waste)	*Environmental Protection (Waste Management) Policy 2000*
EPP(Water)	*Environmental Protection (Water) Policy 2009*
ERA	Environmentally Relevant Activity
ERP	Emergency Response Plan
ESA	Environmentally Sensitive Area
ESD	Ecologically Sustainable Development
EVNT	Endangered, Vulnerable and Near Threatened
FBA	Fitzroy Basin Association
FIFO	Fly-in fly-out
FTE	Full time equivalent
GAWB	Gladstone Area Water Board
GGH	Gladstone Gas Hub
GHG	Greenhouse gas
GIS	Geographical Information System
GLNG	Gladstone Liquefied Natural Gas
GQAL	Good Quality Agricultural Land
GPC	Gladstone Port Corporation
GPS	Global Positioning System
GRP	Gross Regional Product
GSDA	Gladstone State Development Area
GST	Goods and Services Tax
GVA	Gross Value Added
ha	hectares
HAZOP	Hazard and Operability
HDD	Horizontal Directional Drilling
HHMP	Historic Heritage Management Plan
HSE	Health, Safety and Environment
IAS	Initial Advice Statement
ICHA	Initial Cultural Heritage Assessment
ICHRD	Indigenous Cultural Heritage Register and Database
ICOMOS	International Council on Monuments and Sites
IDAS	Integrated Development Assessment System
IEMS	Integrated Environmental Management System

Abbreviation / acronym	Meaning
ILUA	Indigenous Land Use Agreement
IO	Input-output
IP Act	*Integrated Planning Act 1997*
JHA	Job Hazard Analysis
kL	Kilolitre
km	Kilometre
km/h	Kilometre per hour
KP	Kilometre Point
kV	Kilovolt
kVA	Kilovolt ampere
L	Litre
Land Act	*Land Act 1994*
LGA	Local Government Area
LNG	Liquefied Natural Gas
LoS	Level of Service
LP Act	*Land Protection (Pest and Stock Route Management) Act 2002*
LP Regulation	*Land Protection (Pest and Stock Route Management) Regulation 2003*
MAOP	Maximum Allowable Operating Pressure
m	Metre
m^2	Squared metres
m^3	Cubic metres
m/s	Metres per second
MDL	Mineral Development Licence
ML	Mining Lease or Megalitre
mm	Millimetres
MNES	Matters of National Environmental Significance
MSDS	Material Safety Data Sheet
MW	Megawatt
NC Act	*Nature Conservation Act 1992*
NCR	Non-Conformance Report
NGA	National Greenhouse Accounts
NH	National Highway
NIC	Northern Infrastructure Corridor
NNTT	National Native Title Tribunal
NO	Nitrogen dioxide
NQ Dry Tropics	North Queensland Dry Tropics (Land and Water Solutions)

Abbreviation / acronym	Meaning
NRM	Natural Resource Management
NRM Plan	Natural Resource Management Plan
NT Act	Commonwealth *Native Title Act 1993*
NTDA	Native Title Determination Application
ntu	Nephelometric Turbidity Units
NWQMS	National Water Quality Management Strategy
OESR	Office of Economic and Statistical Research
OH&S	Occupational Health and Safety
P&G Act	*Petroleum and Gas (Production and Safety) Act 2004*
PASS	Potential acid sulfate soils
PCHA	Post-Construction Heritage Agreement
PL	Petroleum Lease
$PM_{2.5}$	Particulate matter (up to 2.5 micrometers in size)
PM_{10}	Particulate matter (up to 10 micrometers in size)
PMAV	Property Map of Assessable Vegetation
PNG	Papua New Guinea
PPE	Personal protective equipment
PPL	Petroleum Pipeline Licence
PSL	Petroleum Survey Licence
QFRS	Queensland Fire and Rescue Service
QGC	Queensland Gas Company
QGEOP	Queensland Government Environmental Offset Policy
QH Act	*Queensland Heritage Act 1992*
QHR	Queensland Heritage Register
QLUMP	Queensland Land Use Mapping Program
QNI	Queensland Nickel Industry Pty Ltd
QWQG	Queensland Water Quality Guidelines 2009
RE	Regional Ecosystem
ROP	Resource Operations Plan
ROW	Right of Way
RPD	Real Property Description
RR	Regional Road
SCL	Strategic Cropping Land
SCP	Stakeholder Consultation Plan
SCR	State Controlled Road
SDA	State Development Area

Abbreviation / acronym	Meaning
SDPWO Act	*State Development and Public Works Organisation Act 1971*
SGIC	Stanwell-Gladstone Infrastructure Corridor
SGP	Surat Gladstone Pipeline, now known as ASP
Shell	Royal Dutch Shell plc
SIA	Social Impact Assessment
SIMP	Social Impact Management Plan
SL	Saraji Lateral
SLA	Statistical Local Area
SMS	Safety Management Study
SP Act	*Sustainable Planning Act 2009*
SP Regulation	*Sustainable Planning Regulation 2009*
SPP	State Planning Policy
SRTM	Shuttle Radar Topographic Mission
SSR	State Strategic Road
t	Tonnes
TCP	Transport Coordination Plan for Queensland 2008
TI Act	*Transport Infrastructure Act 1994*
TIA	Traffic Impact Assessment
TMP	Traffic Management Plan
TO Act	*Transport Operations (Road Use Management) Act 1995*
TOR	Terms of Reference
TP&C Act	*Transport Planning and Coordination Act 1994*
UHF	Ultra-high frequency
UV	Ultraviolet
UXO	Unexploded ordnance
VHF	Very high frequency
VM Act	*Vegetation Management Act 1999*
vpd	Vehicles per day
vph	Vehicles per hour
WMP	Waste Management Plan
WONS	Weeds of National Significance
WRP	Water Resource Plan

GLOSSARY OF TERMS AND DEFINITIONS

Term	Definition
Ambient	Surrounding or background.
Ambient noise	The sum of the noise from all sources, near and far, in a given environment.
Anthropogenic	Caused by humans or human activity.
Annual Return	An annual return is a report that describes environmental management activities at the project site for the previous 12 months. Refer to the fact sheet Annual Return and Fee – Mining, Gas and Petroleum (Level 2), November 2010.
ANZECC/ ARMCANZ	The Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand.
Aquifer	Rock or sediment in a formation, group of formations or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.
Aquitard	A bed of low permeability along an aquifer.
Amenity	A feature that increases attractiveness or value, especially of a piece of real estate or a geographic location.
Anabranch	A stream that branches from a main river then reunites with it.
Average Minimum Background Noise Level	Assessed as the background noise level per standard time interval that was exceeded for ninety per cent of the interval, defined in AS1055 as the rating background noise level.
A-weighted	Filtering a sound level so that a microphone output approximates the frequency response of a human ear to the sound.
Background noise	The noise ordinarily present and continuous at a given location, excluding extraneous noise and the noise source of interest. Commonly measured using the statistical parameter, LA90, the A-weighted noise level that was exceeded for ninety per cent of the monitoring period.
Biodiversity	The variety of all life forms on earth – the different plants, animals and micro-organisms, their genes, and the terrestrial, marine and freshwater ecosystems of which they are a part..
Bioregion	Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities.
Blasting	An action using or detonating explosives that may emit a loud, intense sound.
Building and Construction Contracts Structured Training Policy (10 per cent training policy)	The policy requires that a minimum of 10 per cent of the total labour hours on any Queensland Government building or civil construction project (valued over $250,000 for building or $500,000 for civil construction) must be undertaken by Indigenous workers, apprentices, trainees or cadets or used for the upskilling of existing employees (to a maximum of 25 per cent of the deemed hours).
Bund	An embankment constructed around an area to prevent the inflow or outflow of liquids. Also called Bunding.
Catchment	A water intake area or all parts of a drainage basin.

Term	Definition
Cathodic Protection	A method used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell.
Confined Aquifer	An aquifer that is overlain by a confining bed. The confining bed has a significantly lower hydraulic conductivity than the aquifer.
Carbon Dioxide Equivalent (CO2eq)	A measure used to compare the emissions from various greenhouse gases based on their global warming potential.
Combustible	Capable of igniting or burning.
Community values	Aspects of the social and physical environment in which the members of the community value, including the area‘s natural assets, community lifestyle, social networks, scenic areas and recreational facilities.
Cultural significance	The aesthetic, historic, scientific, social or spiritual value for past, present or future generations.
dB	Abbreviation for decibel—the unit of sound measurement.
dB(A)	‗A‘ Weighted overall sound pressure level.
Decibel (weighted) dBA	The measurement of sound pressure level in which the amplitude of the sound signal is negatively weighted in frequencies below 1000 Hz in accordance with a weighing scale known as the ‗A‘ weighing scale. This scale was established to closely simulate human perception of the relative level of pure tone sounds.
Dissolved Oxygen (DO)	The amount of oxygen dissolved in water.
Drainage pattern	The pattern formed by drainage lines, gullies, streams and rivers.
Erosion	The wearing away of land surface by wind or water.
Ecological Sustainable Development (ESD)	Development that improves the quality of life in a way that maintains the ecological processes on which life depends.
Economic Assessment	Provides information on the potential economic impacts of the project at regional, state and national levels. It also indicates strategies for capitalising on economic benefits while at the same time mitigating any possible negative impacts.
Environmental Authority	Licence or Approval issued under the *Environmental Protection Act 1994* to conduct specified Chapter 5A activities and Chapter 4 Environmentally Relevant Activities.
Environmental impact assessment procedures	Environmental impact assessment procedures applied pursuant to State or Commonwealth legislation to integrate environmental management with the approvals process for proposals.
Environmentally Relevant Activities	Activities prescribed under the *Environmental Protection Act 1994* that have the potential to cause environmental harm. They require assessment and approval under environmental legislation.
Environmentally Sensitive Area	An area which contains a natural feature, such as the habitat of a rare species, and which is protected by environmental state legislation. These areas are grouped into category A and B environmentally sensitive area, which can be found in the Environmental Protection Regulation 2008 and category C areas as determined by DERM. Examples are national parks, an area of critical habitat or major interest identified under a conservation plan or nature refuges.

Term	Definition
Ephemeral	A stream that flows briefly only in direct response to precipitation in the immediate locality and the channel of which at all times remains above the water table.
Environmental Management Register	A land use planning and management register, controlled by Queensland's Department of Environment and Resource Management. The EMR provides information on historic and current land use – including whether the land has been or is currently used for a notifiable activity, or has been contaminated by a hazardous contaminant.
Frequency (Hz)	The human ear responds to sound in the frequency range of 20 Hertz to 20,000 Hz. A combination of sound pressure and frequency determine perceived loudness. The centre frequency of an octave is double the frequency of the lower octave. Sound measurements are usually taken at 16 one third octave bands between 50 and 5000 Hz.
Geotechnical	Studies to investigate subsurface conditions and materials and to determine the relevant physical/mechanical and chemical properties of these materials.
Geographical Information Systems (GIS)	A system designed to capture, store, manipulate, analyse, manage and present all types of geographically referenced data. GIS is the merging of cartography, statistical analysis and database technology.
Geohazard	A geological state that represents or has the potential to develop further into a situation leading to damage or uncontrolled risk.
Geomorphology	The description and interpretation of landforms.
Good quality agricultural land (GQAL)	Land which is capable of sustainable use for agriculture, with a reasonable level of inputs, and without causing degradation of land or other natural resources. In this context, agricultural land is defined as land used for crop or animal production, but excluding intensive animal uses such as feedlots, piggeries, poultry farms and plant nurseries based on either hydroponics or imported growth media.
Greenhouse gases	Gases such as carbon dioxide (CO2), water vapour (H2O), nitrous oxide (N2O), ozone (O3) and methane (CH4) which, when dispersed in the atmosphere, tend to trap heat and warm the planetary surface.
Hazchem	Abbreviation used for the hazardous chemical substances coding system used in the Australian Code for the Transportation of Dangerous Goods by Road and Rail. The system is defined in the Australian Standard AS 1216 and uses a classification and labelling system adopted by the United Nations.
HAZOP	Abbreviation used for a Hazard and Operability study for above ground facilities.
Heavy vehicle	A truck, transport or other vehicle with a gross vehicle weight above a specified level (for example: over 8 t).
Heritage	Places, objects and indigenous languages that have aesthetic, architectural, historical, scientific, technological or social significance of other special value for future generations as well as for the community today.
Horizon	A soil horizon is one of the series of distinct layers found in a vertical cross-section of any well-developed soil. The properties of horizons are used to distinguish between soils and are critical for determining land-use potential.

Term	Definition
Horizontal Directional Drilling (HDD)	Horizontal direction drilling is a trenchless method of installing underground pipes in a shallow arc along a prescribed bore path by using a surface launched drilling rig.
Hydraulic	Of or relating to water or other liquid in motion; operated, moved, or effected by water or liquid.
Hydrostatic pressure testing	Pressure testing of a section of the pipeline with water to establish the strength and leak tightness of the test section and to confirm the strength of the pipeline.
Indigenous Land Use Agreement (ILUA)	An agreement between native title holders or claimants and other interested parties about how land and waters in the area covered by the agreement will be used and managed in the future.
Initial Advice Statement (IAS)	Documentation containing project details provided by the proponent when submitting the draft Terms of Reference to the administering authority.
Intermittent noise	A noise whose sound pressure level suddenly drops to the background level several times during the period of observation, the time during which the level remains at a constant value different from that of the background level being of the order of 1s or more.
Landslip	A movement of land surface and sub-surface over relatively short distances and possible long timeframes.
Landslide	Where sections of land break away and move large distances in a short time period.
L10	Noise level exceeded for 10% of the measurement period. This represents the upper intrusive noise level and is often used to represent traffic/ music noise.
L90	Noise level exceeded for 90% of the measurement period. This represents the background noise level excluding nearby sources. Also known as LBG.
Leq	Energy averaged noise level over the measurement period. This measure is commonly used when comparing the criterion noise level under the Environmental Noise Regulations and for comparison with relevant standards for air conditioning noise.
Lmax	Maximum instantaneous noise level during a measured period.
Macroinvertebrate	An invertebrate large enough to be seen without magnification.
Macrophyte	A plant large enough to be seen with the naked eye.
Maximum Allowable Operating Pressure	Refers to the wall strength of a pressurised cylinder such as a pipeline or storage tank and how much pressure the walls may safely hold in normal operation.
Microchiropteran	Of bats, small or micro bat species.
Mining Leases (MLs)	A lease granted pursuant to the Mineral Resources Act 1989 to mine a mineral, e.g. coal, specified in the lease and associated activities.
Particulate matter	Minute airborne particles.
Perched water table	Water table that is positioned above the normal water table for an area because of the presence of an impermeable rock layer.
Perennial	Lasting for an indefinite amount of time.
Permeability	The capacity of a material to transmit fluid.

Term	Definition
Petroleum Leases (PLs)	A lease granted under the Petroleum and Gas (Production and Safety) Act 2004 for the right to explore for, test for production, and produce petroleum within the area of the lease
Petroleum Pipeline Licences (PPLs)	A licence granted under the Petroleum and Gas (Production and Safety) Act 2004 for the right to construct a pipeline to transport petroleum on land subject to the licence.
Pigging	A process for cleaning line pipes
Pipeline	The buried steel gas transmission pipeline will be up to 42 inch (DN1050) in nominal diameter.
PM10	Particulate matter with an aerodynamic diameter of 10 micrometers or less.
PM2.5	Particulate matter with an aerodynamic diameter of 2.5 micrometers or less
Port Alma	Port Alma is a shipping terminal located in the northern counterpart of the Port of Gladstone. It is managed by the Gladstone Ports Corporation.
Probable Maximum Flood	The flood resulting from probable maximum precipitation and, where applicable, snowmelt, coupled with the worst flood-producing catchment conditions that can be realistically expected in the prevailing meteorological conditions.
Project	The Arrow Bowen Pipeline project includes the proposed pipeline route, above ground facilities, temporary workers' accommodation camps and temporary support facilities. Refer to section 1.2 Project description of the EIS.
Project area	The area that may be impacted on directly or indirectly by the project.
Project site	The pipeline lease area.
Proposed pipeline route	Used when describing the route of the pipeline e.g. the proposed pipeline route will commence at Red Hill, approximately 90 km north of Moranbah in Central Queensland and terminate at a proposed Arrow Energy gas gathering station near the Bruce Highway west of Gladstone where it will join the Arrow Surat Pipeline. The proposed pipeline route will be approximately 580 km long and consists of • The Arrow Bowen (AB) mainline (477.3 km); • The Elphinstone Lateral (EL) (52 km); • The Saraji Lateral (SL) (25.7 km); and • The Dysart Lateral (DL) (25.8 km).
Putrescibles	Material that is likely to become putrid.
Qualitative	An assessment based on descriptions or distinctions and quality or characteristic rather than on some quantity or measured
Quantitative	An assessment based on the amount or number of something.
Ramsar	An international treaty for the conservation and sustainable use of wetlands. The treaty was adopted in the Iranian city of Ramsar in 1971.
receptor	A land-use, human being, flora/fauna species, building, residence, community, watercourse or water feature which can be impacted by the development.
Recharge	Water flowing into an aquifer.

Term	Definition
Recharge Area	An area in which there are downward components of hydraulic head in the aquifer. Infiltration moves downward into the deeper parts of an aquifer in a recharge area.
Remnant vegetation	Remnant vegetation means vegetation, part of which forms the predominant canopy of the vegetation— a. covering more than 50% of the undisturbed predominant canopy; and b. averaging more than 70% of the vegetation's undisturbed height; and c. composed of species characteristic of the vegetation's undisturbed predominant canopy.
Right Of Way (ROW)	The area cleared for the construction of the pipeline.
Riparian	Pertaining to, or situated on the bank of, a body of water, especially a watercourse such as a river.
Salinity	The total content of dissolved solids in groundwater, commonly expressed as parts of dissolved solids per million parts of solution (ppm), or milligrams of dissolved solids per litre of solution (mg/L). The significance of salinity depends on its nature as well as the amount of the dissolved solids.
Saturation	The extent or degree to which the voids in rock contain water; usually expressed as a percent related to total void or pore space.
Seismic	Relating to an earthquake or to other tremors of the Earth, such as those caused by large explosions.
Social Impact Assessment	Includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planning interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment.
Sodic	Having a high sodium content.
Sodicity	The level of exchangeable sodium cations in the soil, typically expressed as a percentage (ESP). It relates to likely dispersion on wetting and hence ability to be eroded and transported in stormwater. An ESP of greater than 6% is sodic and greater than 15% is strongly sodic. ESP levels can be lower in soils that are more saline.
Solvents	A substance in which another substance is dissolved, forming a solution.
Sound Attenuation	The reduction in the intensity or in the sound pressure level of sound which is transmitted from one point to another.
Sound Power Level	The total sound energy radiated from a source per unit of time. Ten times the logarithm to the base 10 of the ratio of a given power to a reference power.
Stakeholders	Groups, companies or individuals who may be potentially affected, or have a particular interest in a proposal/development. Stakeholders may include local residents, government agencies, Aboriginal groups/Land Councils/Councils of Elders, local businesses, relevant business and industry groups, community groups, potential competitors and politicians/elected representatives.

Term	Definition
State Development Area	Created under Section 77 of the State Development and Public Works Organisation Act 1971. Their creation promotes economic development and addresses areas of market failure in the development of industrial land and multi-user infrastructure corridors in Queensland.
Statistical Local Area (SLA)	The smallest level of geography/general purpose spatial unit contained in the Australia Standard Geographical Classification (ASGC) in non-census years.
Strategic Cropping Land (SCL)	Defined by the Queensland Government as the best cropping land and as a finite resource subject to a range of competing land-use activities, including agriculture, mining and urban development.
Steady-state noise	A noise having negligibly small fluctuations of sound pressure level within the period of observation.
Subcatchment	An area within a catchment drained by one or more tributaries of the main water body.
Substrate	The underlying base to something, e.g. the streambed.
Topography	The study of the Earth's surface, relief, shape and features.
Topsoil	The upper most layer of soil where most plant nutrients are found.
Total dissolved solids (TDS)	The concentration of common dissolved salts found in water and reported by volume (mg/L).
Total suspended solids (TSS)	The concentration of filterable particles in water (retained on a 0.45 m filter) and reported by volume (mg/L).
Toxicity	The degree of poison or ill effects that a substance produces.
Traditional owners	Traditional Aboriginal owners or other Aborigines to whom the protection of an area is entrusted in accordance with Aboriginal tradition.
Trenching	A narrow excavation made below the surface of the ground, to a depth of typically 1,800 mm.
Turbidity	A measure of the cloudiness of water which is determined by the amount of light scattered by suspended particles.
Wastewater	Water used in a process to carry unwanted materials away or process water that can no longer be used or is surplus to the process.
Water Table	Level below which the ground is saturated with water.

THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

1. INTRODUCTION

Arrow Bowen Pipeline Pty Ltd (Arrow) is the proponent for the Arrow Bowen Pipeline project (the project). Arrow is a subsidiary of Arrow Energy Pty Ltd (Arrow Energy), a wholly owned subsidiary of Arrow Energy Holdings Pty Ltd (the Parent Company). The project consists of approximately 580 km of pipelines which will convey coal seam gas (CSG) for subsequent export as liquefied natural gas (LNG) and associated above ground infrastructure. The purpose of the project is to deliver CSG from Arrow Energy‘s gas fields in the Bowen Basin to a proposed Arrow Energy gas gathering hub in the Aldoga precinct of the Gladstone State Development Area (GSDA) for further transmission to Arrow Energy‘s proposed Arrow LNG Plant on Curtis Island.

The pipeline will be a buried steel gas transmission pipeline of up to 42 inch (DN 1050) in nominal diameter and consists of the Arrow Bowen (AB) mainline and three lateral pipelines; namely the Elphinstone Lateral (EL), Saraji Lateral (SL) and the Dysart Lateral (DL). The proposed pipeline route will commence at Red Hill, approximately 90 km north of Moranbah in Central Queensland and will terminate at Arrow Energy's proposed gas gathering hub (the Gladstone Gas Hub (GGH)), where it will join the Arrow Surat Pipeline (ASP), formerly known as the Surat Gladstone Pipeline, approximately 22 km southwest of Gladstone (refer to **Figure 1-1**).

The pipeline will be of welded steel and will be designed, constructed, operated and decommissioned in accordance with Australian Standard 2885 *Pipelines – Gas and Liquid Petroleum* (AS 2885) and other applicable standards and regulations (including the Australian Pipeline Industry Association (APIA) *Code of Environmental Practice – Onshore Pipelines*).

The pipeline will be licensed and approved pursuant to the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) and the *Environmental Protection Act 1994* (EP Act).

The pipeline will have a minimum technical design life of 40 years, however, with ongoing integrity management, the operational life is expected to be in excess of this figure.

This Environmental Impact Statement (EIS) has been prepared to:

- Facilitate understanding of the project and inform the wider community about the project;
- Assess the existing environment (physical, social, economic) within the project area[1];

[1] The project area refers to the area that may be impacted directly or indirectly by the project

- Identify potential environmental, social and economic impacts and constraints associated with the construction, operation and subsequent decommissioning of the pipeline;
- Detail appropriate measures to avoid or mitigate any potential adverse impacts identified as an outcome of the impact assessment process; and
- Inform a decision on whether the project should proceed and if so, what conditions ought to be reasonably applied to the project.

The EIS has been prepared at Arrow's initiative as a voluntary submission under Part 2 of the EP Act. It will be used to inform an assessment by the Queensland Department of Environment and Resource Management (DERM) for the issuing of an Environmental Authority (EA) for a Level 1, Chapter 5A Activity and associated Chapter 4 Environmentally Relevant Activities (ERAs). The relevant petroleum activity, as defined at Schedule 5 of the *Environmental Protection Regulation 2008* (EP Regulation), is -*constructing a new pipeline of more than 150 km under a petroleum authority*".

The EIS will form the basis of the information required for a Petroleum Pipeline Licence (PPL) application for a Level 1 EA.

The EIS will be of particular interest to a number of stakeholder groups including:

- Commonwealth and state regulatory agencies and relevant government departments;
- Local councils along the proposed pipeline route;
- Landholders, leaseholders, easement holders, native title claimants, residents and business interests along the proposed pipeline route;
- Environmental groups;
- Cultural heritage interests; and
- Mining and petroleum tenement holders.

Consultation with these stakeholder groups has been undertaken and will be on-going throughout the project. Each stakeholder's input will inform the final planning for the project and facilitate community understanding and support for the project.

The EIS satisfies the Terms of Reference (TOR) (refer **Appendix A1**, **Volume 3**) that were prepared in consultation with DERM and issued on 7 July 2011.

ARROW BOWEN PIPELINE PRELIMINARY ROUTE (REV D)

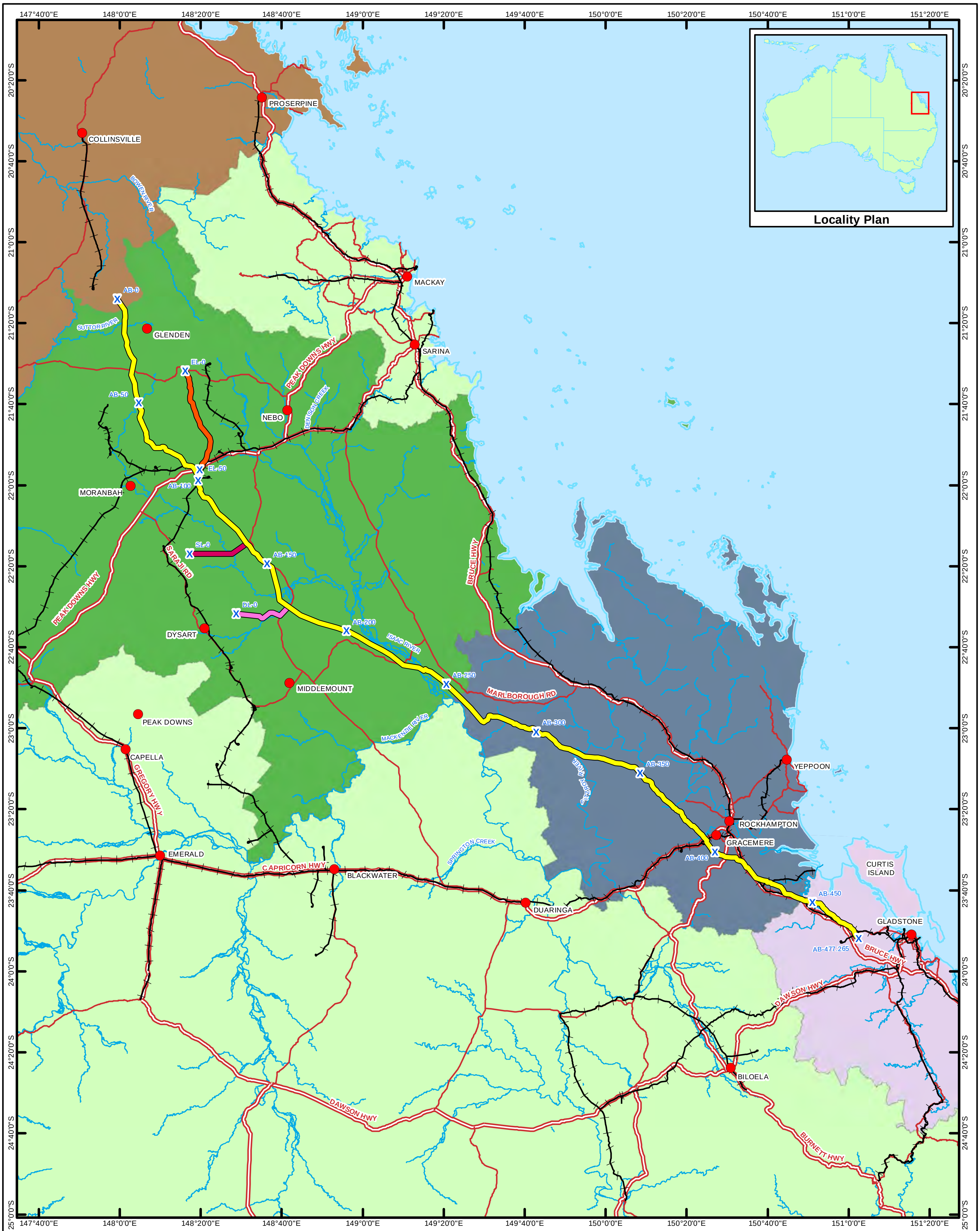


Figure 1 - 1: Project overview

Legend

- Localities
- Kilometre Points
- AB Mainline Rev D
- Dysart Lateral Rev D
- Elphinstone Lateral Rev D
- Saraji Lateral Rev D
- Railways
- Highways
- Major Roads
- Major Watercourses

Local Government Area 2011

- Gladstone Regional
- Isaac Regional
- Rockhampton Regional
- Whitsunday Regional

Data Sources:
StreetPro: Localities, Roads, Railways
DERM: LGA, Major Watercourses
Data Supplied by Arrow Energy:
ABP Mainline RevD,
ABP Lateral RevD
Kilometre Points

N

arrow energy
go further

0 25 50
Kilometres

Scale: 1:2,250,000 @ A4
Coordinate System: GCS GDA 1994

Document: I:\ENVR\Projects\EN02962\Spatial\ArcGIS\V1\Figure_1_1_Project_Overview.mxd Date: 5/12/2011

NOT FOR CONSTRUCTION

1.1. PROJECT PROPONENT

The project proponent is Arrow Bowen Pipeline Pty Ltd (Arrow), a wholly owned subsidiary of Arrow Energy Pty Ltd (Arrow Energy), which is, in turn, a subsidiary of Arrow Energy Holdings Pty Ltd (the Parent Company). Arrow Energy is a leading Australian-based integrated energy company with its primary business activities focused on the exploration, appraisal and development of CSG, a cleaner burning fuel commonly used for electricity generation. The corporate contact details for Arrow are provided in **Table 1-1**.

Table 1-1: Project proponent details

Project proponent:	Arrow Bowen Pipeline Pty Ltd (Arrow)
ACN:	141 181 295
Registered address:	Level 19, AM 60, 42-60 Albert Street, Brisbane QLD 4000

Arrow Energy is an integrated energy company with interests that cover the spectrum of CSG activities ranging from exploration to production, transportation and electricity generation.

Arrow Energy is wholly owned by subsidiaries of Royal Dutch Shell plc (Shell) and PetroChina Company Limited (PetroChina). Both Shell and PetroChina have an established history of working together on the development of energy projects and bring the technical capabilities, capital backing, major project experience and LNG marketing ability to accelerate Arrow Energy's business goals.

Shell has had a presence in Australia since 1901. Current operations include refining, sale of petroleum products and retail businesses. Shell maintains equity in the exploration and development of large gas resources off the coasts of Western Australia and the Northern Territory. As an internationally recognised leader in LNG production, Shell has delivered some of the world‘s largest and most complex LNG projects in the last 40 years including facilities in Qatar, Nigeria, Russia and various projects throughout Southeast Asia. Through its subsidiary, Shell International Trading and Shipping Company Limited, Shell operates one of the largest LNG carrier fleets in the world.

PetroChina is a subsidiary of China‘s largest state-owned oil and gas producer and distributor, and one of the world‘s largest oil companies. PetroChina was incorporated as a joint stock company in 1999, as part of the restructuring of the China National Petroleum Corporation. PetroChina brings extensive experience in exploration, refining and marketing of oil and natural gas in China and other countries.

Arrow Energy and its related companies and joint venture partners has equity interest in more than 65,000 km^2 of petroleum tenures and CSG exploration tenements throughout Queensland and New South Wales with most of these within Queensland‘s Surat and Bowen basins.

Arrow Energy currently operates, or is a major participant in, a number of gas production facilities and supporting infrastructure as well as power stations utilising CSG. Arrow Energy's acreage position and current CSG assets in Queensland is illustrated in **Figure 1-2**.

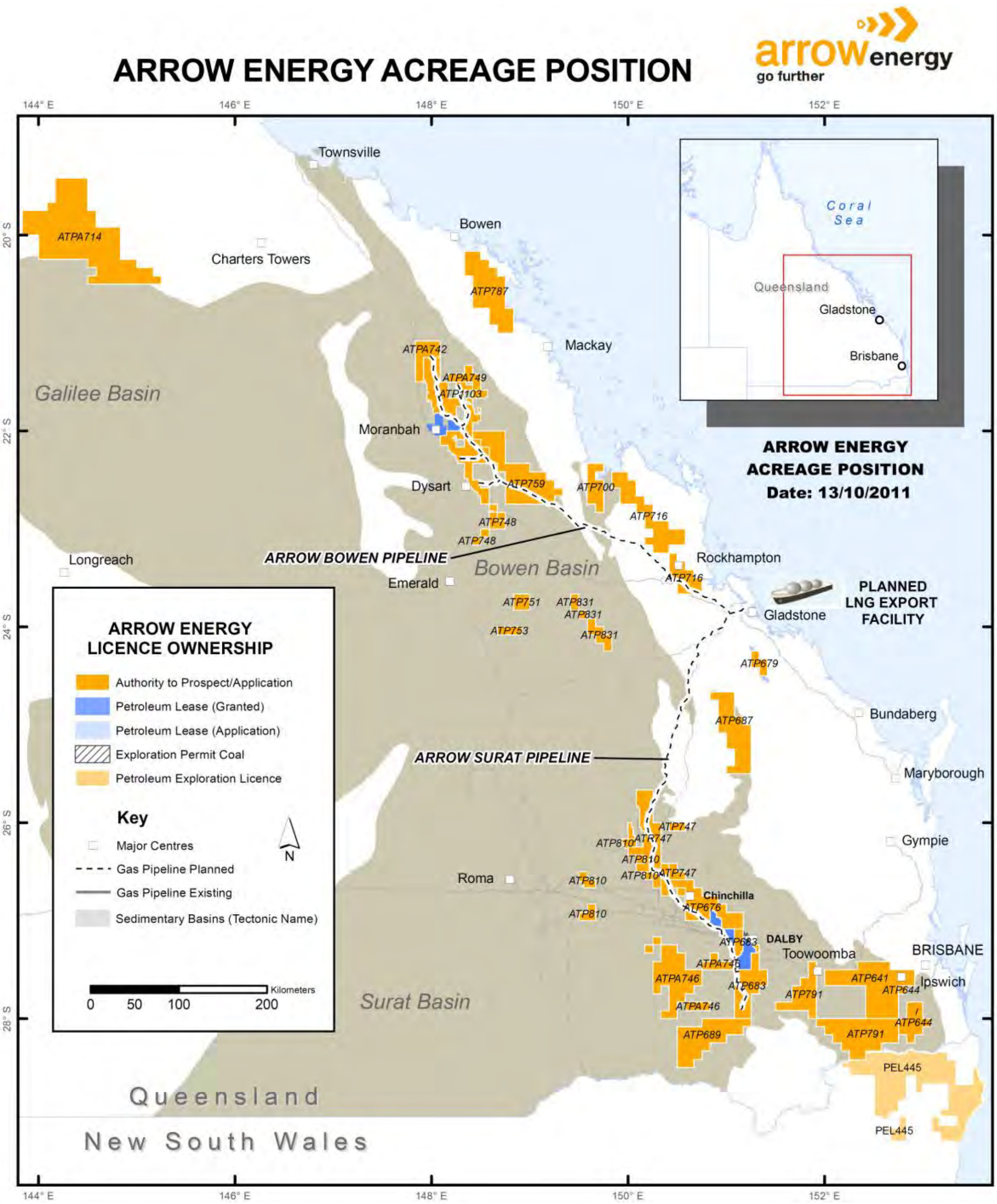


Figure 1-2: Arrow Energy's acreage position and CSG assets in Queensland

Arrow Energy and its equity partner, AGL Energy, have access rights to the existing North Queensland Pipeline (PPL89) which supplies gas to Townsville from the Moranbah Gas Project. Arrow Energy, together with AGL Energy, also holds the pipeline licence (PPL121) for the proposed 440 km long Central Queensland Gas Pipeline (CQP) between Moranbah and Gladstone. The proposed Arrow Surat Pipeline (ASP), formerly known as the Surat Gladstone Pipeline (SGP), connecting Arrow's Surat Basin CSG developments to Gladstone has been approved and a pipeline licence (PPL144) has been granted by the Department of Employment, Economic Development and Innovation (DEEDI).

Arrow Energy's CSG projects related to the midstream of their projects are in various stages of assessment and development as outlined in **Table 1-2**.

Table 1-2: Arrow Energy's related proposed projects

Project name	Description
Bowen Gas Project (Upstream)	The proposed upstream gas field development in the Bowen Basin is located between Collinsville in the north and Middlemount in the south, approximately 475 km north of Brisbane and 75 km south of Mackay. It will see the staged development of Arrow Energy's tenures adjacent to the existing Moranbah Gas Project which is one of the largest operating CSG projects in Australia. An EIS for the Bowen Basin Project will commence early 2012 with an Initial Advice Statement (IAS) proposed to be submitted to DERM in the first quarter of 2012.
Surat Gas Project (Upstream)	Arrow Energy proposes an expansion of its CSG operations in the Surat Basin as part of the proposed Surat Gas Project. The project will involve the staged development of approximately 7,500 production wells, compression facilities and associated pipelines in an area from near Wandoan in the north, via its existing fields near Dalby, to near Goondiwindi in the south. The project has been determined to be a controlled action by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) pursuant to the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act). An EIS is underway and is expected to be submitted in late 2011. The EIS for the Surat Gas Project will be processed under the Bilateral Agreement between the Commonwealth of Australia and the State of Queensland.
Arrow Surat Pipeline (ASP) (formerly the Surat Gladstone Pipeline) (Midstream)	The proposed 480 km long high pressure gas transmission pipeline will connect Arrow Energy's fields in the Surat Basin to the proposed Arrow LNG Plant at Curtis Island. An EIS for the project under the EP Act has already been approved and a petroleum pipeline licence (PPL144) has been granted by DEEDI. The project proponent is Surat Gladstone Pipeline Pty Ltd, a subsidiary of Arrow Energy. Construction is expected to commence in 2015/16.
Surat Header Pipeline (Midstream)	The proposed 110 km long high pressure gas transmission pipeline will connect the ASP to the gas processing and compression facilities and will be located in the southern region of the Surat Gas Project development area. It is intended to be assessed as a Level 2 EA under the EP Act.

Project name	Description
Arrow LNG Plant (Downstream)	The proposed Arrow LNG Plant provides an opportunity for Arrow Energy to commercialise its gas for LNG export. An EIS under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) is being prepared by Arrow Energy for the proposed LNG facility on Curtis Island, a gas pipeline from the mainland to the LNG Plant on Curtis Island (via a tunnel), construction of marine facilities, and minor dredging within Port Curtis facilitate access to Arrow Energy launch sites and material offloading facilities. The EIS is expected to be submitted in late 2011.
Port of Gladstone Western Basin Strategic Dredging and Disposal Project	The project was approved in July 2010 and provides for dredging required to facilitate the development of LNG facilities in Port Curtis, including the extension of shipping channels and development of swing basins. Gladstone Ports Corporation's Port of Gladstone Western Basin Strategic Dredging and Disposal Project was declared a significant project on 24 April 2009.

1.1.1. ARROW ENERGY'S CUSTOMERS AND CONTRACTS

Arrow Energy has a number of Gas Sales Agreements with external parties including:

- CS Energy;
- Queensland Nickel Industry Pty Ltd;
- Copper Refineries Pty Ltd;
- Moranbah Power Station;
- Braemar 1 and 2 Power Stations;
- Daandine Power Station; and
- Dyno Nobel.

Arrow Energy supplies gas to the Daandine, Braemar 1 and 2, Townsville and Swanbank E power stations which participate in the National Electricity Market. With Arrow Energy's full ownership of Braemar 2, and the commercial arrangements in place for Daandine and Townsville power stations, Arrow has access of up to 600 MW of power generation capacity.

1.2. PROJECT DESCRIPTION

The project comprises the construction and operation of:

- The Arrow Bowen (AB) mainline, which runs approximately 477 km from 18 km northwest of Glenden to a proposed GGH to join the proposed Arrow Surat Pipeline (ASP) approximately 22 km west of Gladstone;
- The Elphinstone Lateral (EL), which runs approximately 52 km from 25 km southeast of Glenden to the AB mainline, 29 km east of Moranbah;
- The Saraji Lateral (SL), which runs approximately 26 km from 11 km east of the Peak Downs Mine to the AB mainline about 36 km east of the Peak Downs Mine;
- The Dysart Lateral (DL), which runs approximately 26 km from 14 km northeast of Dysart to the AB mainline about 37 km northeast of Dysart;
- Temporary workers‘ accommodation camps which will move along the proposed pipeline route with construction (total of five camps with only two camps expected to be operational at any one time);
- Temporary support facilities including laydown areas for equipment and pipe delivery and storage and access including the Right of Way (ROW);
- Temporary gates and fences as required; and
- Above ground facilities including main line valves, scraper stations, cathodic protection systems and gas gathering stations.

Construction of the project will be typical of modern gas pipeline projects and will involve the following key steps:

- Clearing of vegetation and grading of the ROW to prepare a safe construction working area;
- Separating and stockpiling of topsoil and subsoil to protect and preserve topsoil;
- Crossing watercourses, roads and rail lines by open cut trench or Horizontal Directional Drilling (HDD) methods (depending upon the type and nature of the crossing);
- Welding of pipe sections to form ―a string” and checking weld integrity;
- Creating a trench in which to lay the pipeline. This will be undertaken by trenching machines and may include the use of rock saws, excavators, rock hammers or blasting in hard rock terrain;

- Lowering the pipeline string into the trench and placing padding (e.g. screened trench subsoil), where required, around the pipe to protect the external coating from damage;
- Backfilling the trench with excavated material and replacing topsoil to its original horizons;
- Testing the structural integrity of the pipeline by filling it with water, and pressurising it to 125% of the Maximum Allowable Operating Pressure (MAOP);
- Safely disposing or reusing of hydrostatic test waters; and
- Cleaning up and restoring the construction ROW.

The pipeline will have a minimum technical design life of 40 years, however, with ongoing integrity management the operational life is expected to be greater. At this stage, construction of the project is anticipated to commence in 2016 with the first gas supplied to the proposed Arrow LNG Plant at Curtis Island scheduled for 2017.

Following construction of the pipeline, landholders will be able to resume use of the land, other than excavation activities or erection of permanent structures or buildings. Deep-rooted vegetation, such as trees, cannot be planted on top of the pipeline due to the need to undertake annual cathodic protection surveys along the pipeline route.

A 30 m wide ROW required for construction of the pipeline will be converted into a 30 m wide operational easement for subsequent operation. Above ground structures will be provided within the ROW and operational easement and will include valves and scraper stations which will be fenced and appropriately signed. Pipeline markers will be provided at fences, road crossings and other locations as required by AS 2885.

A routine operation and maintenance program, which will include a variety of maintenance activities, will be implemented during operation. Aerial and ground inspections will include checking of the easement condition, checking of cathodic protection performance, monitoring of rehabilitation success and detection of weed species and potentially incompatible land uses.

Continued access to the easement will also be necessary to for maintenance and follow up of any issues identified from inspections. Inspection of the easement to ensure success of the rehabilitation, including erosion and weed management, is likely to be necessary, particularly during the first year following construction.

If, and when, the pipeline is no longer required, it will be decommissioned and all above ground infrastructure will be disposed of appropriately in accordance with the legislative requirements applicable at the time.

A more detailed project description is provided in **Chapter 3**.

1.3. PROJECT OBJECTIVES AND SCOPE

There is an increasing local, national and global demand for cleaner, carbon-efficient energy. Arrow Energy is a leader in CSG development in Queensland, and the project forms part of Arrow Energy‘s commitment to deliver gas to the export market by:

- Developing Queensland‘s gas reserves and presenting a commercially-sound and reliable investment for the export economy;
- Developing identified opportunities in the export LNG markets at a time when energy supply is in deficit and a continued growth in global demand anticipated;
- Utilising a fuel source regarded internationally as a cleaner fuel source with lower greenhouse gas emissions compared to other fossil fuels;
- Strengthening both Queensland‘s and Arrow Energy‘s position as leaders in CSG development in Australia and globally; and
- Increasing Arrow Energy‘s business value through commercialising CSG reserves held in Arrow Energy‘s petroleum tenures for LNG export markets.

The project forms a key link in Arrow Energy‘s long term strategy of creating a gas pipeline network connecting Arrow Energy‘s upstream reserves with market opportunities, comprising the project, the ASP and the existing North Queensland Gas Pipeline. The pipeline network will connect Arrow Energy‘s gas fields in the Surat and Bowen basins to their customers and power stations at Daandine and Braemar in the Surat, the proposed Arrow LNG Plant in Gladstone, and through a connection to be developed in the future, to customers in Moranbah as well as customers and the power station at Townsville.

The objectives of the project include:

- Contributing towards meeting growing global demand for LNG;
- Consolidating Australia‘s reputation as a reliable producer of quality LNG;
- Providing a cleaner alternative source of energy for industry, including power generation;
- Assisting to insulate the Australian and Queensland economies against adverse international trends;
- Adding to Queensland‘s long term infrastructure inventory;
- Assisting Queensland to develop a new and lucrative export industry;
- Further diversifying Queensland‘s energy industry away from greenhouse-intensive fossil fuels;

- Progressing development of Queensland's CSG industry;
- Continuing Queensland's entry into the expanding LNG industry; and
- Providing market opportunities for Arrow Energy's CSG reserves in the Bowen Basin.

1.3.1. PROJECT ALTERNATIVES

There are a number of potential alternatives associated with the project and the proposed pipeline route including:

- Development of the CQP;
- Not developing the project;
- Alternative pipeline route options; and
- Changes to project design, construction techniques and environmental impact mitigation measures.

Each of the above alternatives is discussed in detail in **Section 2.2**. The consequences of not proceeding with the project would mean the non-realisation of many project benefits including:

- Creation of a new long term CSG processing and export industry in Queensland utilising Arrow Energy's Bowen Basin reserves. The use of CQP to achieve this is considered unlikely due to its smaller diameter and the need to re-route the first 150 km of it to avoid overlapping tenure issues involving sterilisation of a number of coal reserves;
- Direct (immediate and future) employment opportunities through job creation and indirectly through goods and services provision. Construction and operational activities are expected to extend through the life of the development;
- Growth of economies in local cities (Rockhampton and Gladstone) and townships (including Moranbah, Dysart, Middlemount and Bajool) through the provision of increased goods and services. Arrow will continue to use suppliers and contractors from local and surrounding areas where feasible to maximise local benefits;
- Arrow's intention to create a multi-billion dollar investment in the Surat and Bowen gas fields, and on Curtis Island;
- Diversification of many local and national industries and economies through the introduction of new technology and business in the region; and

- Substantial cash flows to the Australian Government through increased Goods and Services Tax (GST), company tax and personal income tax and to the Queensland Government through royalties and payroll tax.

Overall, the project will help achieve increased competition in the gas supply market, greater potential export markets and direct economic benefit from construction expenditure and longer term benefits of the project operation.

1.3.2. PROJECT SCHEDULE

Arrow proposes to award the contract for construction of the pipeline in 2014/2015. The contractor will have the responsibility for development of a detailed construction schedule that meets the completion deadline.

It is envisaged that the project will be constructed over 15 months, beginning in April 2016 and spread over the 2016 and 2017 dry seasons. However, circumstances such as adverse weather and potential collaboration with other pipeline construction projects in the region could extend the proposed construction period. Operation of the project will commence in 2017.

The overall proposed project schedule is provided in **Table 1-3**.

Table 1-3: Project schedule

Milestone	Target date
Submission of EIS to DERM	December 2011
Supplementary EIS report	Third quarter in 2012
EPBC approval with conditions	Second quarter in 2013
PPL decision and issue of Level 1 Environmental Authority	Second quarter 2013
Final investment decision	Late 2013
Front End Engineering & Design	2013
Contract award	2014/15
Commence pipeline construction	April 2016
Commence pipeline commissioning	End 2017
Commercial pipeline operation	2017 / 2018

1.3.3. PROJECT EXPENDITURE

The allocation of capital and construction expenditure is shown in **Table 1-4**. Of the $1,207 million estimated total construction expenditure, $808 million is expected to be sourced from Australia while the rest will be imported line pipe and valves (which are not manufactured in Australia). Arrow expect that operations of the pipeline will cost approximately $2 million per annum which has been allocated solely to the Australian and New Zealand Standard Industrial Classification (ANZIC) Water, Pipeline and Other Transport industry with a separate decommissioning expenditure of $690,000 occurring in 2059.

Table 1-4: Expenditure – construction of the project ($m)

Industry allocation	Expenditure ($m)
Heavy and civil engineering construction	412.0
Specialised and other machinery and equipment manufacturing	219.0
Wholesale trade	76.0
Road transport	11.4
Non-residential building construction	19.0
Electricity transmission, distribution, on selling and electricity market operation	15.2
Water supply, sewerage and drainage services	15.2
Waste collection, treatment and disposal services	15.2
Iron and steel manufacturing	25.0
Total	**808.0**

Refer to **Section 4.12** and the *Economic Assessment* included in **Appendix 4.1**, **Volume 3** for further information.

1.3.4. CURRENT PROJECT STATUS

It is expected that upon completion of the EIS process, award of the contract for construction will be undertaken following the final investment decision to be taken by Arrow Energy on the upstream field development, pipeline and the proposed Arrow LNG Plant. Separate EIS processes are being undertaken for the upstream field development and the proposed Arrow LNG Plant. Detailed design for the pipeline will be completed following final investment decision and prior to construction commencing.

1.3.5. RELATIONSHIP TO OTHER PROJECTS

The southern end of the proposed pipeline route is planned to be located in the Stanwell-Gladstone Infrastructure Corridor (SGIC) State Development Area (SDA) which is identified as being able to accommodate up to seven pipelines. The Gladstone Pacific Nickel slurry pipeline and the Fitzroy to Gladstone water pipeline have yet to be constructed but are also proposed to be located within this SDA.

The proposed pipeline route will cross three other proposed CSG pipelines from the Surat Basin to Gladstone, namely the Queensland Curtis LNG Pipeline (QGC/BG), the GLNG Pipeline (Santos / PETRONAS / TOTAL) and the Australian Pacific LNG Pipeline (Origin Energy / Conoco Philips) near the crossing of the East End Junction to Bajool Railway.

The consequences of not proceeding with the project would mean that the Arrow LNG Project on Curtis Island could not proceed and the non-realisation of the benefits which would be to the detriment of the local, regional, state and national economies.

1.3.6. METHODOLOGY OF THE EIS

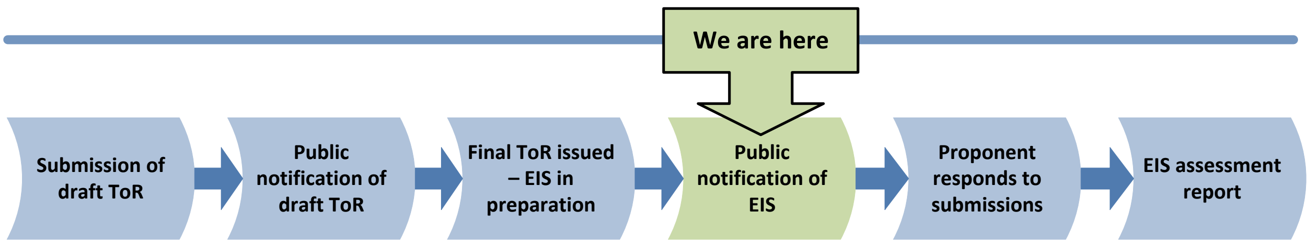
The Chief Executive for DERM is responsible for the coordination of the environmental impact assessment for an EIS submitted under the EP Act for petroleum activities.

Pursuant to the EP Act, and in order for the Chief Executive to decide whether an EIS was required for the project, an Initial Advice Statement (IAS) describing the project and application for the preparation of a voluntary EIS was prepared and submitted to DERM on 16 February 2011. The IAS was based on a desktop assessment of the project area.

DERM assessed the application to prepare a voluntary EIS and notified Arrow on 23 February 2011 that approval had been granted. In accordance with Section 41 of the EP Act, Arrow prepared a draft TOR to commence the EIS process for the project which was submitted to the Chief Executive of DERM on 24 February 2011.

The draft TOR was publically notified on 19 March 2011 with submissions invited from 21 March 2011 until 6 May 2011. Submissions on the TOR were received and reviewed by DERM before being finalised on 18 May 2011. Arrow prepared its response to these comments on 15 June 2011. DERM subsequently issued the final TOR, which forms the basis of the EIS, on 7 July 2011 and published them on DERM's website on 9 July 2011. The final TOR is presented in **Appendix A1**, **Volume 3**.

The assessment process is illustrated in **Figure 1-3**.



(Source: Department of Environment and Resource Management, 2011)

Figure 1-3: EIS assessment process

In line with the TOR issued by DERM, appropriate mechanisms for informing and consulting affected and interested parties, and the wider community are discussed in **Section 1.3.8**.

1.3.7. OBJECTIVES OF THE EIS

The EIS is a public document and is Arrow's formal response to the TOR issued by DERM for the project. It is the key environmental submission providing advice to decision makers considering approvals for the project pursuant to the EP Act.

The key objectives of the EIS are to:

- Provide public information on the need for the project and its likely environmental, economic and social impacts and benefits;
- Set out acceptable standards and levels of impacts (both beneficial and adverse) on environmental, and social and economic values;
- Demonstrate how environmental impacts can be managed through the protection and enhancement of the environmental, and social and economic values;
- Demonstrate the relationship to the project of environmental management, planning documentation, conditions, approvals and environmental, and social and economic authorities;
- Outline the project and pipeline route alternatives considered and the likely environmental outcomes; and
- Provide a draft Environmental Management Plan (EMP) and list project commitments.

1.3.8. SUBMISSIONS

As a central part of the EIS process, the public are invited to review the EIS and provide comment.

A person has the right to make a submission on this project to the chief executive of the Department of Environment and Resource Management (DERM) within the stated submission period. The chief executive will accept a submission pursuant to section 55 of the *Environmental Protection Act 1994* (EP Act) if it:

- Is written;
- Is signed by or for each person (signatory) who made the submission;
- States the name and address of each signatory;
- Is made to the chief executive; and
- Is received on or before the last day of the submission period.

The EIS has been publically notified and the chief executive of DERM has allowed a 30 business day period for acceptance of public submissions on the EIS. All submissions, comments and enquiries regarding this EIS process should be addressed to:

The Chief Executive
Statewide Impact Assessments
Department of Environment and Resource Management
Attention: The EIS Coordinator (Arrow Bowen Pipeline Project)
Floor 3, 400 George Street, BRISBANE, QLD, 4000
GPO Box 2454, BRISBANE, QLD, 4001
Telephone: 13 74 68 (13GOV)
Facsimile: (0) 3330 5754
Email: eis@derm.qld.gov.au

The chief executive of DERM may require the Proponent to prepare responses to properly made submissions on the EIS.

Members of the public may view the EIS documents during the submission period on the Arrow Energy web site: www.arrowenergy.com/page/Projects/Arrow_Bowen_Pipeline, or at the following locations during business hours.

Name	Address			
Department of Environment and Resource Management	Floor 3, 400 George Street	BRISBANE	QLD	4000
Moranbah Library	Grosvenor Complex	MORANBAH	QLD	4744
Emerald Library	44 Borilla Street	EMERALD	QLD	4720
Dysart Library	Shannon Crsecent	DYSART	QLD	4745
Nebo Library	10 Reynolds Street	NEBO	QLD	4742
Rockhampton Regional Council	232 Bolsover Street	ROCKHAMPTON	QLD	4700
Gladstone Regional Council	101 Goondoon Street	GLADSTONE	QLD	4680
Whitsunday Regional Council	83-85 Main Street	PROSERPINE	QLD	4800

1.4. PUBLIC CONSULTATION PROCESS

Undertaking appropriate and effective stakeholder consultation is an essential element of the project. Arrow has developed a Stakeholder Consultation Plan (SCP) which clearly states the stakeholder and community engagement goals, processes and outcomes, and how these will be achieved in a timely and effective manner. The objectives of the SCP are to:

- Identify project stakeholders, their needs and their values;
- Identify the key stakeholder issues to be addressed during consultation;
- Facilitate involvement with the community through a two-way flow of information between the project team and the public;
- Actively encourage community input in an atmosphere of cooperation, support and encouragement;
- Provide information on the EIS process;
- Seek input on key issues and concerns and suggestions to mitigate these concerns;
- Provide information on the outcomes of studies undertaken;
- Demonstrate that possible issues of concern to the community have been identified and considered during the EIS process;
- Ensure the community is informed about the project's goals and economic benefits;
- Maintain an open channel of communication with stakeholders; and
- Create an environment in which stakeholders and the public are more likely to support than oppose the project.

The SCP will be maintained for the duration of the planning, construction and commissioning phases of the project. Arrow will maintain an active stakeholder liaison program during the operational phase.

In accordance with the SCP, Arrow has undertaken consultation (and is continuing to undertake consultation) with a range of stakeholders for the project, including affected landholders, government agencies and local government. While other interested parties may be identified as the project is progressed, key stakeholders already identified are outlined in **Table 1-5**.

Consultation methods to be used throughout the project development, in accordance with the SCP, include:

- One-on-one meetings with local governments, relevant government departments and agencies (including regional offices), Member of Parliament representing the area (state and Commonwealth), landholders, residents, indigenous interests, community groups, business groups and special interest groups;
- Individual face-to-face consultations and negotiations with landholders and residents, which are ongoing for the life of the project;
- Preparation and wide distribution of printed digital information, factsheets, project updates and special reports;
- Establishment of a database of key stakeholders to advise of progress, to note, and monitor concerns and to open and maintain communication channels;
- Use of local newspapers and community announcements to disseminate information at key points in the project;
- Internet access to project information;
- Community sessions along the proposed pipeline route as appropriate during planning and EIS public comments period; and
- Regular project group planning and information sharing meetings.

Table 1-5: Stakeholders for the project

Category	Entity
State government advisory agencies and elected representatives	Department of Environment and Resource Management
	Department of Infrastructure and Planning
	Department of Transport and Main Roads
	Department of Employment, Economic Development and Innovation
	Department of Emergency Services
	Department of Mines and Energy
	Queensland Police Service
	Department of Communities
	Department of Community Safety
	State and Commonwealth Members of Parliament
	Whitsunday Regional Council
	Isaac Regional Council
	Rockhampton Regional Council
	Gladstone Regional Council

Category	Entity
Community associations and landcare groups	Capricorn Conservation Council Inc.
	Fitzroy Basin Association
	Gladstone Economic and Industry Development Board
	Mackay Conservation Group
	Queensland Conservation Council
	Calliope Landcare
	Yarwun Targinnine Progress Association
	Mackay-Whitsunday-Isaac Regional Economic Development Corporation
Registered Native Title parties	Birri People (QUD6244/98, QC98/12)
	Jangga People (QUD6230/98, QC98/10)
	Wiri People (QUD372/06, QC06/14)
	Barada Barna People (QUD380/08, QC08/11)
	Darumbal People 2 (QUD6001/99, QC99/1)
	Darumbul People (QUD6131/98, QC97/)
	Port Curtis Coral Coast People (QUD6026/01, QC01/29)
Other LNG proponents	Queensland Gas Company (QGC) / British Gas (BG)
	Santos / PETRONAS and TOTAL
	Origin Energy / Conoco Philips
Petroleum and mineral tenement holders	CH4 Pty Ltd (PL)
	Central Queensland Pipeline Pty Ltd (PPL)
	Stanwell Corporation Limited (PPL)
	Jemena Queensland Gas Pipeline (1) Pty Ltd (PPL)
	QCLNG Pipeline Pty Ltd (PPL)
	Surat Gladstone Pipeline Pty Ltd (PPL)
	Peabody (Burton Coal) Pty Ltd (ML)
	Vale Australia (CQ) Pty Ltd (ML)
	Coppabella Coal Pty Ltd (ML)
	Macarthur Coal Pty Ltd (ML)
	Xstrata plc.
	BHP Billiton Ltd.
	Aquila

Category	Entity
Operators of existing utilities and infrastructure	Ergon Energy
	Powerlink
	Optus
	Telstra
	Queensland Rail (passenger) and Queensland Rail National (freight)
	SunWater
	Gladstone Ports Corporation / Central Queensland Port Authority
Landholders	All affected landholders along the proposed pipeline route

Refer to the **Section 4.9** and the *Social Impact Assessment* included in **Appendix A4.2**, **Volume 3** for further detail on the SCP.

1.5. PROJECT APPROVALS

The pipeline will be licensed and approved pursuant to the P&G Act and an EA under the EP Act will be required from DERM for a Level 1 Chapter 5A Activity prior to pipeline construction and commissioning. The relevant Level 1 Activity is for ~~-~~constructing a new pipeline of more than 150 km under a petroleum authority".

A number of additional approvals will be required following DERM's assessment of the EIS and DEEDI's grant of the PPL. These will be obtained at a later date once full details of construction and operation are known. Applications for Development Approvals will be made under the Integrated Development Assessment System (IDAS) pursuant to the *Sustainable Planning Act 2009* (SP Act). Refer to **Section 1.5.1.4** and **Appendix A2**, **Volume 3**.

The legislation listed and the approvals and permits required to be obtained by Arrow are a best estimate of what is required based on current legislation. Legislation, regulations, policies and guidelines are subject to change and any changes to legislation, regulations, policies and guidelines which are enacted in the future may alter this position. In the event this occurs, Arrow will have regard to such legislation, regulations, policies and guidelines and the relevant approval and permit required at the time.

1.5.1. RELEVANT LEGISLATION AND POLICY REQUIREMENTS

A number of Commonwealth and state planning legislation, local statutory instruments and policies apply to the project. A review of relevant legislation, statutory instruments and policies has been undertaken for the project and is summarised below.

1.5.1.1. Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act applies to those actions which are likely to have a significant impact on matters of National Environmental Significance (MNES). The eight matters of MNES protected under the EPBC Act are:

- World heritage properties;
- National heritage places;
- Wetlands of international importance (listed under the RAMSAR Convention);
- Listed threatened species and ecological communities;
- Migratory species protected under international agreements;
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park; and
- Nuclear actions (including uranium mines).

The project will be referred to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) for determination as to whether it constitutes a ‗controlled action' under the EPBC Act once the results of ecological surveys have been assessed and potential impacts identified. This decision will be made with consideration of the project's potential to impact upon matters of MNES. A ‗controlled action' requires formal assessment and approval.

As the project has not yet been referred to the DSEWPAC for determination, the processing of the EIS under Queensland State legislation is not intended to act as an assessment for the EPBC Act purposes under the Bilateral Agreement between the Commonwealth of Australia and the State of Queensland.

Native Title Act 1993

The purpose of the *Native Title Act 1993* (NT Act) is to provide for the recognition and protection of native title rights for Australia's indigenous people, as well as providing a legislative approach for dealing with matters of native title.

Under the NT Act, indigenous rights may exist in areas such as vacant or unallocated crown land, some reserve lands and some types of pastoral lease and waters that are not privately owned. In accordance with the NT Act, a native title process will be undertaken with native title claimants and regulatory agencies over lands for which native title has not been extinguished.

In order for an activity to be valid in relation to native title, there must be compliance with Division 3 of Part 2 of the NT Act which provides a hierarchical list of approval mechanisms by which proponents can address project impacts on native title. The two relevant mechanisms in the NT Act are either entry into an Indigenous Land Use Agreement (ILUA) with the relevant native title party or the extinguishment of native title by compulsory acquisition.

Arrow intends to develop ILUAs with relevant native title parties along the proposed pipeline route and work on these respective ILUAs is well advanced.

Aboriginal and Torres Strait Island Heritage Protection Act 1984

The *Aboriginal and Torres Strait Island Heritage Protection Act 1984* (ATSIHP Act) is administered by the DSEWPAC. The Act provides Indigenous (Aboriginal and Torres Strait Island) people in any Australian state or territory (with certain caveats pertaining to Victoria) with the right to request the relevant Commonwealth Minister to intervene in matters where traditional cultural heritage interests are considered to be at risk. Only Indigenous people or their agents can make use of the provisions of the ATSIHP Act and the Minister has discretionary powers of intervention in any particular case. In summary, any process of negotiation and mediation under the state Government legislation should be exhausted before the Commonwealth Minister intervenes.

Cultural Heritage Management Plans (CHMPs) will be contained in the relevant ILUAs (currently being prepared by Arrow) or be developed separately for approval by DERM to satisfactorily address the cultural heritage interest of the relevant Aboriginal Endorsed Parties along the proposed pipeline route. It is considered that the ILUA / CHMP will comply with the ATSIHP Act and the NT Act as well as applicable state government cultural heritage legislation.

1.5.1.2. State legislation

Petroleum and Gas (Production and Safety) Act 2004

The P&G Act facilitates and regulates the carrying out of responsible petroleum activities and the development of a safe, efficient and viable petroleum and fuel gas industry in Queensland.

Arrow has an approved EA (PEN201616610) and a Petroleum Survey Licence (PSL) (PSL 64) for the project from DERM and DEEDI respectively pursuant to Chapter 4, Part 1 of the P&G Act. PSL 64 provides land access, enabling field assessments to be undertaken for ecological and cultural heritage surveys and engineering and construction inspections, particularly to refine pipeline route selection.

Under the P&G Act a point-to-point PPL authorising the construction and operation of the pipeline (including all connected facilities e.g. valve, scraper and meter stations, plant and equipment) will be required from the Minister of DEEDI. Similar to a PSL, an EA is required for the project from DERM before the PPL can be issued.

A PPL exempts some pipeline activities from approval under other Acts, for example vegetation clearing under the *Vegetation Management Act 1999* (VM Act). Exemptions only apply if works are conducted for activities authorised under the PPL and located within the specified PPL area.

The proponent is required to obtain an interest in all the land impacted by the proposed pipeline route. This involves obtaining an interest in the form of a negotiated land access agreement or easement option over the affected land. The pipeline easement width required for the project is generally 30 m. The construction contractor may also require temporary access to additional land during construction for turning bays, access tracks, and possibly bypass tracks around areas where the ROW width is constrained by environmental concerns. Where this is required, the contractor will make its own arrangements with the landholders. Arrow is currently actively negotiating with landholders as described in **Section 1.4** and **Section 4.9**. Negotiations will continue with the landholders on issues relating to compensation and terms and conditions of individual land access agreements.

There is provision for the state to provide access to land for the purposes of an infrastructure facility of significance (such as a pipeline) under Section 125 of the SDPWO Act. Where landholders or native title claimants do not enter into land access agreements, Arrow may rely on state intervention to obtain access to these parcels of land through a compulsory acquisition process provided that Arrow can demonstrate that it has made genuine and repeated attempts to obtain this access by direct agreement with the landholder.

Environmental Protection Act 1994

The EIS has been prepared pursuant to the EP Act which regulates impacts on Queensland's environment. Under the EP Act, DERM is the responsible authority for the following:

- Administration of EAs and ERAs;
- Monitoring environmental performance;
- Conducting site inspections and environmental audits;
- Managing EISs as required;
- Concurrence agency for assessments not undertaken under the EP Act;
- Regulating financial assurance for petroleum activities and ensuring adequate rehabilitation standards; and
- Enforcing compliance with environmental controls including impacts on contaminated land and referable wetlands.

The EIS has been prepared as a voluntary submission under Chapter 3 of Part 2 of the EP Act for assessment by the Chief Executive of DERM. As part of the EIS, an EMP has been drafted and identifies the environmental protection commitments to help DERM decide the conditions of the EA for petroleum activities (refer **Chapter 5**). Further, the Standard Criteria defined in Schedule 4 of the EP Act have been considered in the preparation of the EIS and are presented in **Appendix A3**, **Volume 3**.

Environmentally Relevant Activities

Petroleum activities are classified within two levels of ERAs based on the risk of environmental harm from released contaminants. Construction of a new transmission pipeline is classified as a Level 1 petroleum activity. To undertake a Level 1 petroleum activity, an EA must be issued by DERM.

An EA is required to be granted and issued by DERM before a PPL can be granted. As part of the EA application, a detailed report and an EMP will need to be developed and submitted. The EMP is included in **Chapter 5** and outlines the general environmental and social aspects of the project (including associated facilities, temporary workers‘ accommodation camps) and will set environmental protection commitments for construction and operations.

ERAs are defined under Schedule 2 of the EP Regulation, and are activities with the potential to release contaminants to the environment and cause environmental harm. The Level 1 Chapter 5A Activities and ERAs considered to apply to the project are identified in **Table 1-6**.

Table 1-6: Potential Level 1 Chapter 5A Activities and ERAs for the project

ERA and threshold	Description	Aggregate environmental score	Application and assumptions
Schedule 5(5)	Constructing a new pipeline of more than 150 km under a petroleum authority	165	Required for pipeline construction and operation including ancillary activities.
Schedule 5 (8)	A petroleum activity, other than a petroleum activity mentioned in items 1 to 7, that includes a chapter 4 activity for which an aggregate environmental score is stated.	126 (or highest individual score)	Required for pipeline construction and operation including ancillary activities.
14(2)	Electricity generation – consists of generating electricity by using fuel (other than gas) at a rated capacity of 10 MW electrical or more.	76 (10 MW to 150 MW) or 151 (150 MW or more)	Required for temporary workers‘ accommodation camps. ERA approval will be obtained from DERM under the IDAS pursuant to the SP Act.
15 (1)	Fuel burning – consists of using fuel burning equipment that is capable of burning at least 500 kg of fuel in an hour.	35	Using diesel generators to meet energy requirements for the temporary workers‘ accommodation camps.

ERA and threshold	Description	Aggregate environmental score	Application and assumptions
33(1)	Crushing, milling, grinding or screening – consists of crushing, grinding, milling or screening more than 5000 t of material in a year.	N/A	Required for rock crushing and quarry materials for construction of the project.
63(1)(a); (3)(2)(b) – more than 100 to 1500EP	Sewerage treatment – consists of operating 1 or more sewage treatment works at a site, other than no release works, with a total daily peak design of more than 100 to 1500 EP.	53	Required for temporary workers' accommodation camps. ERA approval will be obtained from DERM under the IDAS pursuant to the SP Act.
64 (1)(b); (3)(3)	Water treatment – consists of treating 10 ML or more of raw water in a day.	26	May be required to treat temporary workers' accommodation camp water to meet potable demands.

It is noted that approval for ERAs is required from DERM for the temporary workers'accommodation camps (electricity generation, fuel burning and sewerage treatment) and they will be sought separately to the EIS process under the IDAS pursuant to the SP Act.

Environmental Protection Policies

The EP Act enables subordinate legislation which defines environmental objectives and sets targets for achieving these objectives. The following subordinate legislation is applicable to the project:

- *Environmental Protection (Air) Policy 2008* (EPP(Air));
- *Environmental Protection (Noise) Policy 2008* (EPP(Noise));
- *Environmental Protection (Water) Policy 2009* (EPP(Water)); and
- *Environmental Protection (Waste Management) Policy 2000* (EPP(Waste Management)).

Each of these policies identifies the environmental values and performance objectives required to protect these values. These policies have been discussed in **Section 4.4**, **Section 4.5**, **Section 4.6** and **Section 4.7** and have been incorporated into the EMP provided in **Chapter 5** to ensure these environmental values and performance objectives are met.

Sustainable Planning Act 2009

The SP Act establishes the legislative framework for state and local government planning scheme approvals under the IDAS. The SP Act is accompanied by the *Sustainable Planning Regulation 2009* (SP Regulation) which identifies various aspects of development as either assessable, self-assessable, compliance assessable or exempt from assessment.

The pipeline and associated incidental activities that are located within the PPL area, as licensed under the P&G Act, are exempt from assessment against the local planning schemes in accordance with Schedule 4, Table 5, Item 3 of the SP Regulation. Other approvals may be triggered under the SP Act for activities within the PPL area where they are not directly associated with the pipeline. Incidental activities associated with the project, such as temporary workers' accommodation camps, undertaken outside of the PPL area, may require development approval pursuant to the SP Act.

State Development and Public Works Organisation Act 1971

The SDPWO Act establishes an environmental assessment process for projects declared to be ‗significant projects' by the Queensland government. Projects declared significant are generally economically or strategically important for the state, or highly complex requiring centralised coordination or assessment by the Coordinator-General (DEEDI). Division 3 of the SDPWO Act is not relevant to the project as it is not a significant project and Arrow has opted to undertake a voluntary EIS under the provisions of the EP Act.

The SDPWO Act also gives the Coordinator-General power to take land for an infrastructure facility for the benefit of a third party, where an infrastructure facility is defined to include a railway, pipeline, electricity transmission facilities, storage and transmission of gas, transportation facility for coal, and a water management distribution and reticulation facility. The infrastructure facility must be declared to be an infrastructure facility of significance and for this declaration, it will be necessary to establish the strategic significance of the project to the locality, region or state. It is anticipated that Arrow will make an application for an infrastructure facility of significance for the project will be made in 2013.

The SDPWO Act is also relevant to the project as the proposed pipeline route traverses two SDAs, namely the SGIC SDA and the Gladstone SDA (GSDA).

SDAs are created under Section 77 of the SDPWO Act and their creation promotes economic development and addresses areas of market failure in the development of industrial land and multi-user infrastructure corridors in Queensland (DEEDI, 2009-2011).

A SDA does not change the ownership of the land within the declared area. However, the government, through the Coordinator-General, may acquire land and/or easements (by agreement or compulsorily) within a SDA for purposes which can include the establishment of industry, essential services or infrastructure corridors.

Stanwell-Gladstone Infrastructure Corridor State Development Area

The SGIC SDA includes land between Stanwell Energy Park and the GSDA and was identified by the Coordinator-General as an area suitable for housing multiple underground pipelines. The corridor can accommodate up to seven underground pipelines in a single area, for uses including raw, treated and sea water, gas, and mineral slurries, as well as telecommunication cables (DEEDI, 2011).

The dedication of this corridor as a SDA resulted from an identified need to assist the growing demand for essential services such as water and gas within Rockhampton and Gladstone (in particular).

The *Development Scheme for the Stanwell-Gladstone Infrastructure Corridor State Development Area* (development scheme) has been prepared to manage land use in the SGIC SDA. An assessment of the key objectives for development under this development scheme is provided in **Table 1-7**.

Table 1-7: Objectives for development within the SGIC SDA

Objective	Comment
Provide land for underground infrastructure purposes to facilitate economic development in Rockhampton and Gladstone area.	From Rockhampton to Gladstone SGIC SDA is being considered for the proposed pipeline route. This is consistent with the intent of the SGIC SDA (refer to **Section 3.1.2**).
Provide a dedicated and efficient means of access for materials, products, wastes and services between Rockhampton and Gladstone.	The ROW will provide a dedicated and efficient means of access for materials, products, wastes and services along the proposed pipeline route between Rockhampton and Gladstone. Major roads will be utilised to access the ROW (refer to **Section 4.3**).
Provide planned development that recognises environmental values and community values.	The project has considered and assessed a range of environmental and community values. Mitigation measures have also been identified in order to meet the objectives of the SGIC SDA (refer to **Section 4.8** and **Section 4.10**).
Establish a development framework that provides for long term orderly development of the provision of infrastructure in the Rockhampton Gladstone area.	The project is required to deliver CSG to the proposed Arrow LNG Plant for eventual export. The project provides for long term orderly development and is being planned and developed in alignment with other Arrow Energy projects.
Ensure that the integrity and functionality of the SGIC SDA is maintained and protected from land uses and activities that may be incompatible with, or adversely affect, the continued use of the SDA for the purpose of providing an efficient and effective route for materials transportation and services infrastructure between Rockhampton and Gladstone.	The SGIC SDA is a designated infrastructure corridor to house multiple underground pipelines. The project is therefore consistent with the intent of the SGIC SDA.

Gladstone State Development Area

The GSDA was declared in December 1993 and currently includes approximately 29,000 hectares of land in the Gladstone region which is suitable for future large scale industrial development. Land within the GSDA was chosen based on compliance with acceptable engineering, environment and social criteria, as identified in the Gladstone Industrial Land Use Study.

The *Development Scheme for the Gladstone State Development Area* (development scheme) will apply to the project where the proposed pipeline route crosses land in the GSDA. An assessment against the key objectives within the GSDA development scheme is provided in **Table 1-8**.

Table 1-8: Objectives for development within the GSDA

Objective	Comment
Provide, manage and plan land for industrial development of national, state and regional significance and complementary industrial, infrastructure and service uses (within the Aldoga, Targinnie, Yarwun, Clinton and Curtis Island Industry Precincts).	The pipeline easement (30 m) will impact on 146.3 hectares of land within the GSDA which is included in the Materials Transportation and Services Corridor. The project is consistent with the purpose of this corridor (refer to **Section 4.2**).
Provide, manage and plan land for a dedicated and efficient means of access for materials, products, wastes and services between the GSDA (Aldoga, Targinnie, Yarwun, Clinton and Curtis Island Industry Precincts and the Port of Gladstone).	The ROW will provide a means of access for materials, products, wastes and services along the proposed pipeline route and the project is not expected to have high impacts on the existing road network.
Recognise areas of the Surat oil shale resource as a valuable mineral resource, for mining.	Not applicable – the project is not located within the Surat oil shale resource area and is not associated with mining.
Establish a development framework that provides for long term orderly industrial development in the Gladstone region.	The project is required to deliver CSG to the proposed Arrow LNG Plant on Curtis Island for eventual export. The project provides for long term orderly development and is being planned and developed in alignment with other Arrow projects.
Ensure the integrity and functionality of the GSDA is maintained and protected from incompatible land uses and activities that may adversely affect the continued use of the GSDA.	The project is consistent with the integrity and functionality of the GSDA (refer to **Section 4.2.1.2**). The location of the proposed pipeline route within the GSDA will be negotiated with the Coordinator-General (DEEDI).
Encourage the development of synergies between industries to minimise waste production and promote re-use and recycling of waste.	Waste will be managed in accordance with the waste management hierarchy outlined within the EPP (Waste Management) (refer to **Section 4.4**).
Encourage and promote industry having regard to the cultural heritage values of the GSDA.	The proposed pipeline route will avoid places and objects or cultural heritage significance where possible (refer to **Section 4.9**).

Objective	Comment
Ensure the physical characteristics of land are considered in determining the suitability and location of development.	A range of physical characteristics have been considered during the identification of the pipeline route selection for the project (refer to **Section 4.2**).
Ensure development recognises and protects environmental, cultural heritage and community values.	The project has considered and assessed a range of environmental, cultural heritage and community values (refer to **Section 4.8**, **Section 4.9** and **Section 4.10**).
Ensure the impacts of development on the environment, including cumulative impacts are minimised to meet the requirements of applicable government policies.	The design of the proposed pipeline route minimises impacts on environmental values including cumulative impacts. Applicable government policies which have been considered are outlined within each section of the EIS and summarised in **Section 1.5**.
Protect air quality	Potential air quality and greenhouse gas impacts associated with the project have been assessed and the project is not likely to impact on air quality values within the GSDA (refer to **Section 4.6**).
Ensure areas of high ecological significance within and adjacent to the GSDA are protected.	The proposed pipeline route has been designed to minimise the potential impacts on areas of ecological significance (refer to **Section 4.8**).
Provide land and plan for adequate areas of open space within the GSDA.	The pipeline will be buried and is therefore consistent with this objective of the GSDA.

Water Act 2000

The *Water Act 2000* (Water Act) regulates the use, flow and control of water including water in a watercourse, lake or spring, underground water, overland flow water, water that has been collected from a dam and recycled and desalinated water. Such works may include, but are not limited to, pumps, diversion channels, weirs, dams or bores. DERM manages access to water under the Water Act and authorises water licences, water permits (for short term use), water allocations and interim water allocations.

Under the Water Act, activities that will involve vegetation destruction, excavation and fill in a watercourse are exempt from assessment under section 49, 50 and 51 of the *Water Regulation 2002* (Water Regulation) as long as they are authorised under a licence, petroleum lease or authority to prospect under the P&G Act. If works are undertaken outside the PPL area, a Riverine Protection Permit (RPP), which will require the written consent of adjacent land owners, will be required under the Water Act to remove vegetation, excavate and fill within the waterways.

A permit is also required to source water from a watercourse, lake, spring or aquifer for an activity of a temporary nature under section 237 of this Act. Water may be temporarily required during construction of the proposed pipeline route for HDD, hydrotesting, dust suppression and for potable temporary workers‘ accommodation camp water. This permit process is separate to the SP Act and is required regardless of the PPL granted under the P&G Act.

Vegetation Management Act 1999

The VM Act provides for the conservation of native vegetation in Queensland and regulates the clearing of mapped remnant vegetation (termed Regional Ecosystems (RE)) and high value regrowth vegetation on freehold and leasehold land. Approval under VM Act is required if remnant vegetation is to be cleared, with applications for approval likely to be accompanied by a Property Map of Assessable Vegetation (PMAV). An exemption applies where the clearing is for a ‗specific activity' listed in Schedule 24 of the SP Regulation which includes clearing for a chapter 5A activity (Part 1, Item 1(6)).

As such, vegetation clearing on freehold and leasehold land is exempt from assessment under the VM Act where the construction of the proposed pipeline, including incidental activities, is undertaken within the area covered by the PPL. Clearing related to incidental activities outside the PPL area, such as temporary workers' accommodation camps and borrow pits, which involve vegetation clearing will require development approval.

While all practicable efforts will be made to avoid and minimise impacts on vegetation clearing, where residual impacts cannot be avoided, an offset plan will be prepared and implemented to rehabilitate vegetation similar to that of the impacted vegetation in a nearby location. The goal of any offset program will be to achieve a net conservation gain by enhancing the long term sustainability of the vegetation in the Bioregion. Offsets will be developed in liaison with relevant Commonwealth and state regulatory agencies (AECOM, 2011). Refer to **Section 4.8** and **Appendix A4.3**, **Volume 3** for further details on vegetation offsets considered for the project.

Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) has a number of associated regulations, plans and orders to protect Endangered, Vulnerable and Near Threatened (EVNT) species. The objectives of the NC Act are based on principles to conserve biological diversity, ecologically sustainable use of wildlife and Ecologically Sustainable Development (ESD).

The NC Act and regulations state that any person taking, using or interfering with protected EVNT fauna is required to have a Wildlife Rehabilitation Permit (spotter-catcher) and to posses the training and skills required to undertake this activity. Such a permit will allow a person to rescue and release a sick, injured or orphaned protected animal; or a protected animal whose habitat has been, or will be, destroyed by human activity or a natural disaster.

A clearing permit (protected plants) is also required to be obtained from DERM where taking, using or interfering with EVNT flora under the NC Act.

Based on studies undertaken to date for the project, it is likely that impacts to EVNT species can be avoided, so offsets would not be required for state significant biodiversity values.

Further investigations will be undertaken to develop pipeline route revisions in areas where EVNT species have been recorded. Refer to **Section 4.8** and **Appendix A4.3**, and **Appendix A4.4**, **Volume 3** for further information on EVNT species and offsets.

Land Protection (Pest and Stock Route Management) Act 2002

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) and the *Land Protection (Pest and Stock Route Management) Regulation 2003* (LP Regulation) provide for pest and plant management in Queensland. There are three classes of declared pests that are enforced under the LP Act and the management intent varies between each class.

Class 1 species are not generally established in Queensland but have potential to cause adverse economic, environmental or social impacts. The landholder is obliged to take reasonable steps to keep their land free of Class 1 pest species, unless the owner holds a declared pest permit allowing the pests to be kept on the land.

Class 2 species are established in Queensland and can cause significant adverse economical, environmental or social impact. The landholder is obliged to take reasonable steps to keep their land free of Class 2 pest species, unless the owner holds a declared pest permit allowing the pests to be kept on the land.

Class 3 species are established in Queensland and have or could have adverse economical, environmental or social impact. Legislative obligations relating to control these species are generally limited to specific conservation areas.

Refer to **Section 4.8** and **Appendix A4.3**, **Volume 3** for further information on which species were recorded within the project site during field surveys.

Forestry Act 1959

The *Forestry Act 1959* (Forestry Act) provides for forest reservations; the management, silvicultural treatment and protection of state forests; and the sale and disposal of forest products and quarry material, the property of the Crown on state forests, timber reserves and on other lands. All crown land, such as road reserves and stock routes, that contain ‗profitable timber' are also subject to the Forestry Act.

Under section 56 of the Forestry Act, a permit is required to extract material or destroy a tree located on state land within or outside the PPL area. The proposed pipeline route has been aligned to avoid all state forests.

Land Act 1994

The *Land Act 1994* (Land Act) provides a framework for the allocation of state land as leasehold, freehold or other tenure. Under Chapter 4, Part 4 of the Land Act, a permit to occupy is required from DERM where the project is developed on a reserve, road or unallocated state land.

Further, a permit is required under section 113 of the Land Act for clearing of vegetation on all state lands. The application must be made to DERM regardless of whether the clearing will take place within or without the PPL area.

Aboriginal Cultural Heritage Act 2003

All objects and areas of Aboriginal cultural heritage significance in Queensland are dealt with under the *Aboriginal Cultural Heritage Act 2003* (ACH Act). The ACH Act covers places of archaeological and historical significance. The primary determinant of significance of an area or object resides with the Aboriginal parties, in recognition that Aboriginal people are the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage.

The ACH Act operates on the basis of a duty of care owed by development proponents and others to Aboriginal cultural heritage.

In this case, it is necessary that a CHMP or native title agreement be prepared in consultation with the relevant Aboriginal parties to ensure that Aboriginal cultural heritage duty of care is fulfilled. A native title agreement may include an ILUA, section 31 agreement or use of the Native Title Protection Conditions. ILUAs are being prepared for the project with the relevant parties for the project and will include specific measures for the management of Aboriginal cultural heritage. If an ILUA cannot be finalised in accordance with the project's requirements, an approved CHMP will be agreed with the relevant parties.

The ACH Act also provides for the Minister to issue stop orders under section 32 of the Act where there is a risk of, or actual, harm being done to Aboriginal cultural heritage. Substantial fines can arise where a party, individual or corporation is found guilty of harming Aboriginal cultural heritage.

Queensland Heritage Act 1992

Historic heritage in Queensland is protected under the provisions of the *Queensland Heritage Act 1992* (QH Act). This legislation protects all those places included on the Queensland Heritage Register (QHR). It also protects archaeological places where there is an expectation of sub-surface material that can provide information regarding the history of Queensland. Although this Act contains provisions for the protection of indigenous cultural heritage, items that derive their significance solely from their association with Aboriginal custom or tradition are excluded from protection under the QH Act. A non-indigenous heritage assessment (refer **Section 4.9**) has been prepared for the project which addresses the QH Act.

Coastal Protection and Management Act 1995

The *Coastal Protection and Management Act 1995* (Coastal Act) provides for protection, conservation, rehabilitation and management of the coastal zone. It aims to ensure decisions about land use and development safeguard life and property from the threat of coastal hazards.

The *State Coastal Management Plan – Queensland's Coastal Policy* (State Coastal Management Plan) and subsequent Regional Coastal Management Plans have been developed under the Coastal Act to provide ways to protect and manage Queensland's coastal resources. The proposed pipeline route traverses land included in the *Curtis Coast Regional Coastal Management Plan* (Curtis Coastal Plan). Relevant approvals from DERM will need to be sought post EIS for works triggered under the SP Act and Coastal Act.

It is noted that the *Queensland Coastal Plan* has been developed in response to a statutory review of the State Coastal Management Plan and Regional Coastal Management Plans and will replace these plans once in effect (expected sometime in 2011). The *Queensland Coastal Plan* includes two parts, being: the *State Policy for Coastal Management* (State Policy) and the *State Planning Policy for Coastal Protection* (SPP for Coastal Protection). The State Policy addresses land management activities that do not constitute development under the SP Act while the SPP for Coastal Protection contains policies, criteria and maps directed at planning and development outcomes in the coastal zone (refer to **Section 1.5.2.4**).

Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) regulates the management, use, development and protection of fisheries, resources and fish habitats and the management of aquaculture activities. The disturbance of marine plants and the construction and raising of waterway barrier works are administered under the Fisheries Act.

The construction and raising of waterway barrier works is self-assessable where:

- They are intended to exist for no more than 21 calendar days (tidal waterways) or 42 calendar days (non-tidal waterways);
- They are no more than 20 m in length measured across the waterway; and
- They are no more than 10 m wide.

Where waterway barrier works are deemed self-assessable, the works must comply with the Code for self-assessable development, temporary waterway barrier works. If waterway barrier works are not deemed self-assessable, an approval from DEEDI will be required prior to works commencing.

Transport Infrastructure Act 1994

The *Transport Infrastructure Act 1994* (TI Act) regulates infrastructure (including roads, rail, light rail, busways, ports, air, marine and miscellaneous) throughout Queensland and encourages effective integrated planning and efficient management of transport infrastructure.

Approval is required from the Department of Transport and Main Roads (DTMR) and Queensland Rail (QR) to work on, or interfere with, state owned roads and railways respectively. The proposed pipeline route traverses a number of state-controlled roads including:

- Bruce Highway;
- Burnett Highway;
- Capricorn Highway;
- Duaringa-Apis Creek Road;
- Fitzroy Development Road;
- May Downs Road;
- Collinsville - Elphinstone Road;
- Bajool - Port Alma Road;
- Gladstone - Mount Larcom Road;
- Peak Downs Highway; and
- Suttor Developmental Road.

The proposed pipeline route traverses a number of railways including:

- Goonyella Branch Railway Crossing;
- Norwich Park Branch Railway Crossing;
- Central Line Crossing;
- North Coast Railway Crossing; and
- East End Mine Branch Railway Crossing.

Full details of the local, state and national roads to be affected by the proposed pipeline route are identified in **Section 4.3** and the *Traffic Impact Assessment* in **Appendix A4.5**, **Volume 3**. A Traffic Management Plan (TMP) will be prepared for the project prior to construction and will include consultation with DTMR.

Transport Planning and Coordination Act 1994

The *Transport Planning and Coordination Act 1994* (TP&C Act) regulates planning and coordination of transport and other matters for which the Minister is responsible. It aims to improve the economic, trade and regional development performance of Queensland and the quality of life of Queenslanders.

The *Transport Coordination Plan for Queensland 2008 – 2018* (TCP) was developed under the TP&C Act to provide a strategic framework for planning and management of transport resources. The TCP is intended to provide guidance to modal strategies and integrated Regional Transport Plans.

Transport Operations (Road Use Management) Act 1995

The *Transport Operations (Road Use Management) Act 1995* (TO Act) regulates road management and provides for the effective and efficient management of road use in Queensland. Of relevance to the project and in particular, its construction, this Act establishes a scheme to allow management of traffic to enhance safety and transport efficiency.

A number of subordinate regulations provide the guidelines and permitting requirements to ensure the safe movement of vehicles along road transport corridors. Specifically, regard would be given to permits required for the use of oversize vehicles required to transport infrastructure and machinery for the purposes of project works and construction.

Electricity Act 1994

The *Electricity Act 1994* (Electricity Act) administers the electricity industry including use of electricity. Any interference with electricity infrastructure resulting from development must be approved by the relevant entity under the Electricity Act. A number of transmission lines will be traversed by the proposed pipeline route including the Nebo-Moranbah 132 kV overhead transmission line and the Broadsound-Lilyvale 275 kV transmission line.

1.5.1.3. Local statutory instruments

Local government planning schemes

The proposed pipeline route traverses land within four Local Government Areas (LGAs) namely the Whitsunday Regional Council, Isaac Regional Council, Rockhampton Regional Council and Gladstone Regional Council. A number of planning schemes exist to administer development within each LGA, being the planning schemes of the former LGAs in existence prior to the amalgamations in March 2008. The former LGAs and current planning schemes are outlined in **Table 1-9**.

Table 1-9: Local government planning schemes

Local Government Area	Former Local Government Area	Current planning scheme
Whitsunday Regional Council	Former Bowen Shire Council	*Bowen Shire Planning Scheme 2006*
Isaac Regional Council	Former Nebo Shire Council	*Nebo Shire Plan (February 2008)*
	Former Belyando Shire Council	*Belyando Shire Planning Scheme*
	Former Broadsound Shire Council	*The Broadsound Plan*
Rockhampton Regional Council	Former Livingstone Shire Council	*Livingstone Shire Planning Scheme*
	Former Fitzroy Shire Council	*Fitzroy Shire Planning Scheme*
Gladstone Regional Council	Former Calliope Shire Council	*Calliope Shire Planning Scheme 2007*

Each current planning scheme (listed in column three of **Table 1-9**) was developed under the repealed *Integrated Planning Act 1997* (IP Act) and are continued under the transitional provisions provided within the SP Act. New planning schemes are currently being prepared by each LGA in accordance with the Queensland Planning Provisions under the SP Act. Each new planning scheme will reflect the amalgamation of the former LGAs. The new planning schemes for the Whitsunday Regional Council, Isaac Regional Council, Rockhampton Regional Council and Gladstone Regional Council are still being drafted and are not yet on public display. Therefore, only an assessment of the project against the provisions and policies within the current planning schemes can be undertaken within the EIS (refer to **Section 4.2**).

The current planning schemes follow a similar structure and include:

- A Strategic Plan which provides a broad direction for development within the LGA;
- Desired Environmental Outcomes (DEOs) for the (former) LGA which set out broad sustainable outcomes for development in the LGA;
- Land use categories which divide land into preferred zones, localities or preferred use areas;
- Overlays which identify land that may be impacted by bushfire hazard, landslide hazard, environmental protection areas and infrastructure; and
- Development codes which provide specific criteria for carrying out development.

The pipeline cannot be made assessable against a local government planning scheme in accordance with Item 1 and 3, Table 5, Schedule 4 of the SP Regulation; specifically because the pipeline is an activity authorised under the P&G Act and is for petroleum activities. However any aspect of the project which is not directly for petroleum activities and is not authorised under the P&G Act will trigger the requirement for approval under the relevant local government planning scheme (e.g. temporary workers' accommodation camps). Regardless, an assessment of the project against each relevant planning scheme DEO is provided in **Table 1-10** and an assessment against each planning scheme land use category (zoning) is provided within **Section 4.2**.

Table 1-10: Desired Environmental Outcome

Desired Environmental Outcome (DEO)	Comment
Bowen Shire Planning Scheme	
Development does not adversely affect the values of the Shire's natural environment including coastal areas, wetlands, beaches, headlands, waterways, Protected Areas, undeveloped hillslopes, and areas of significant native vegetation, from any adverse effects accruing from clearing, soil degradation and pollution due to erosion and contamination, acidification, salinity, waste disposal and any modifications to natural processes.	The impacts and mitigation measures associated with the Shire's natural environment is assessed in **Section 4.8**. The adverse impacts from land clearing, soil degradation and contamination are dealt with in **Section 4.2**. Waste disposal impacts are addressed in **Section 4.4**.
Development does not adversely affect the quality and quantum of water available for a range of consumptive uses throughout the Shire.	Water quality and water availability for a range of consumptive uses is addressed in **Section 4.5**.
Risks to safety, property and the environment are not increased by the interaction of development and natural or other hazards, including flooding, bushfire, disturbance of acid sulfate soils, storm surge, cyclonic weather events and landslide.	The risks associated with the project including risks to property, the environment and the interaction of the development and natural hazards are addressed in **Section 4.13**.
Development protects the economic values of natural resources including good quality agricultural land, extractive and mineral resources, vegetation and water.	The potential impacts on the economic values associated with natural resources are addressed in **Section 4.12**.
Development provides a benefit to and satisfies an economic demand of residents of the area in which it is located.	The issues associated with the economic demand and economic benefits to the residents within the project area are addressed in **Section 4.12**.
Growth and community development within the Shire focussed on the existing Bowen and Collinsville urban areas to facilitate the efficient use, timely and orderly expansion and continued operation of infrastructure.	The project is required to deliver CSG to the proposed Arrow LNG Plant on Curtis Island (via ASP) for eventual export. The project provides for long term orderly development and is being planned and developed in alignment with other Arrow projects.
Development promotes the efficient use and provides for the orderly expansion of the Shire's movement system, including motorised and non-motorised modes.	The impacts of the project on the existing movement system within the Shire are discussed within **Section 4.3**.

Desired Environmental Outcome (DEO)	Comment
l) Development occurs in an area: (i) which is suitable and compatible with the nature of the development; and (ii) in which services and facilities required in respect of the development are existing, planned or provided by the development.	Potential impacts associated with the compatibility of the development with the local area and the existing land uses required by the project are discussed in **Section 4.2**.
m) Development does not adversely affect: (i) the community's health and safety; (ii) the amenity enjoyed by people in different areas of the Shire; and (iii) the safe and efficient operation of the transport, energy and other infrastructure supporting the Shire and surrounding region.	The potential impacts on the community's health and safety, the amenity enjoyed by people and the safe and efficient operation of the transport and infrastructure in the region is discussed in **Section 4.11** and **Section 4.3**.
n) Development reflects the community's reasonable expectations and harmonises with the natural environment and does not prejudice the Shire's existing scenic amenity, particularly along the coastal plain.	The potential impacts on the scenic amenity of the project area are discussed in **Section 4.2**. Potential impacts on the coastal plain have been considered in **Section 1.5.2.6**.
o) The community values of places and landscapes reflecting the community's history and identity are not detrimentally affected by development.	The potential impacts on the landscape character of the project area are addressed in **Section 4.2**.
Nebo Shire Planning Scheme	
The Shire's rivers and creek systems, and associated catchment areas, are protected from adverse impacts and incompatible development.	The potential impacts on the Shire's rivers and creeks systems as a result of the project are discussed in **Section 4.5**.
Remnant vegetation and, in particular, riparian corridors are protected, maintained and enhanced to maximise biodiversity and areas of flora and fauna habitat.	The potential impacts from the project on the flora and fauna and appropriate mitigation and enhancement measures are provided in **Section 4.8**.
Areas displaying significant landscape values in the Shire are protected from encroachment by incompatible development.	The potential impacts on the landscape character of the project area are discussed in **Section 4.2**.
Good Quality Agricultural Land (GQAL) and other rural lands capable of supporting primary production activities are protected as a significant economic resource.	The potential impacts on GQAL and other rural landscapes as a result of the development are discussed in **Section 4.2**.
Necessary infrastructure, which is protected from incompatible development, is provided in a timely and cost effective manner to support the ongoing development and future establishment of beef production, agricultural farming and coal mining uses to ensure continued economic development within the Shire.	Infrastructure in the project area which may be impacted by the proposed project and which may not be compatible is discussed in **Section 4.2**.
The values or areas or places of cultural heritage significance are protected, maintained and enhanced.	Potential impacts on cultural heritage are discussed in **Section 4.9**.

Desired Environmental Outcome (DEO)	Comment
The provision and safe operation of necessary infrastructure, including water and sewerage systems, roads, electricity supply networks and transmission grid, telecommunication systems, cane tramways and rail networks, in accordance with the differing needs of the urban and rural localities of the Shire.	The project will have limited impacts on the safe operation of necessary infrastructure.
The safety of the communities is maintained by ensuring development does not occur in areas prone to bushfires, flood and/or landslides.	The hazards and risks and potential impacts associated with areas prone to bushfires, flood and/or landslides are discussed in **Section 4.13**.
Belyando Shire Planning Scheme	
In Belyando Shire, ecological systems, the natural environment (including natural features and unique habitats such as Peak Range Forest National Park, Wilandspey Conservation Park, Narrien Range National Park, Epping Forest National Park, Doongmabulla Springs Important Wetlands and the declared catchment), and items and places of cultural and heritage significance are protected such that biodiversity, cultural heritage values and existing or intended landscape character are maintained.	Potential impacts on the natural environment within the project area are assessed in **Section 4.8**. Impacts on cultural heritage are discussed in **Section 4.9** and the impacts on the landscape character of the project area are discussed in **Section 4.2**.
The economy of Belyando Shire is enhanced and diversified in a manner that supports the intended land use structure and character of the urban centres in Clermont and Moranbah and the rural parts of the Shire. This occurs through:— a) diversified economic activities in urban areas; b) the sustainable use of natural resources (including land, water and mineral resources)	The potential impacts of the project on the economy are discussed in **Section 4.12** and the impacts on the land use structure and landscape character of the project area is discussed in **Section 4.2**.
Moranbah and Clermont provide a wide range of government and community services and employment opportunities for their communities and those in surrounding areas. In addition Moranbah has a significant role as the primary service centre for the northern Bowen Basin mining industry.	Potential impacts on the community services and employment opportunities within these communities are assessed in **Section 4.10** and **Section 4.12**.
Broadsound Shire Planning Scheme	
Adverse effects on the qualities and life supporting functions of Broadsound's natural systems are minimised. Air and water quality, soil, biological diversity and ecosystems are protected and enhanced.	Potential adverse impacts on the natural systems and biological diversity of the project area are assessed in **Section 4.8**. Impacts on air, water quality and soil are assessed in **Section 4.6**, **Section 4.5** and **Section 4.2** respectively.
The effects of development on the multiple attributes of the nearby Great Barrier Reef World Heritage Area, coastal and other wetlands and foreshores are minimised.	The project does not impact on the Great Barrier Reef World Heritage Area

Desired Environmental Outcome (DEO)	Comment
Broadsound has a diverse, prosperous local economy with farming and grazing and mining the most prominent activities in the rural area and industry and business primary in towns and villages. Tourism, rural and mining-based business and industries are established in locations throughout the Shire where there is strong nexus to the resources upon which they rely.	The potential impacts on the local economy are assessed in **Section 4.12**.
High standard of public health and safety are maintained, avoiding or minimising adverse effects associated with the natural and built environments, including erosion, flood, storm, tide inundation, fire and traffic hazards, together with safe domestic water supply and responsible waste disposal practices.	Public health and safety and impacts associated with natural hazards are assessed in **Section 4.11** and **Section 4.13**.
Areas and places of special aesthetic, architectural, cultural, historic, scientific, social or spiritual significance and their values are conserved or enhanced.	The potential impacts of the project on the special aesthetic, architectural, cultural, historic, scientific or spiritual significance are discussed in **Section 4.9**.
Residents have access to integrated networks of pleasant and safe public areas for aesthetic enjoyment and cultural, recreational and social interaction, including beaches and natural bushland.	Potential impacts on areas for public access and recreational use are addressed in **Section 4.2** and **Section 4.10**.
Adverse effects for scenic values in coastal areas, bushland and the rural countryside are minimised.	Potential impacts on the scenic values of the bushland and rural countryside are discussed in **Section 4.2**.
A sense of community and community harmony is maintained and reinforced, including minimising conflict between proposed building and works and the design, height and external appearance of existing buildings and works in Broadsound's town and villages or with the rural landscape.	Potential impacts on the community and community harmony in the towns, villages and rural landscapes of the shire are discussed in **Section 4.10**.
Livingstone Shire Council Planning Scheme	
Development does not adversely affect the values of the Shire's natural environment including coastal areas, wetlands, beaches, headlands, waterways, Protected Areas, undeveloped hillslopes, and areas of significant native vegetation, from any adverse effects accruing from clearing, soil degradation and pollution due to erosion and contamination, acidification, salinity, waste disposal and any modifications to natural processes.	Potential adverse impacts on the natural environment including wetlands, waterways, protected areas, undeveloped hillslopes and areas of significant native vegetation are addressed in **Section 4.5** and **Section 4.8**.
Development does not adversely affect the quality and quantum of water available for a range of consumptive uses throughout the Shire.	The impacts on the quality and quantum of water available for a range of uses are assessed in **Section 4.5**.

Desired Environmental Outcome (DEO)	Comment
Risks to safety, property and the environment are not increased by the interaction of development and natural or other hazards, including flooding, bushfires, disturbance of acid sulfate soils, storm, tide, cyclonic weather events and landslide.	Health and safety impacts and the management of hazards and risks are addressed in **Section 4.11** and **Section 4.13**.
Development protects the economic values of natural resources including good quality agricultural land, extractive and mineral resources, vegetation and water.	Impacts associated the economic values of natural resources, good quality agricultural land, etc., are addressed in **Section 4.12**.
Development provides a benefit to and satisfies an economic demand of residents of the area in which it is located.	The provision of economic benefits and demand of residents through the development is dealt with in **Section 4.12**.
Yeppoon continues to function as the main business centre and administrative hub for the Shire.	Impacts on business centres such as Yeppoon are addressed in and **Section 4.12**.
Development occurs in an area: (i) which is intended for the development as identified by the outcomes for zoned land; and (ii) in which services and facilities required in respect of the development are existing, planned or provided by the development.	Land use zones and land use planning impacts are addressed in **Section 4.2**.
Development does not adversely affect: (i) the community's health and safety; or (ii) the amenity enjoyed by people in different areas of the Shire.	The impacts on the community's health and safety and amenity are addressed in **Section 4.11**.
Development reflects the community's reasonable expectations and harmonises with the natural environment and does not prejudice the Shire's existing scenic amenity, particularly along the Capricorn Coast.	Potential impacts on the community's expectation of the natural environment and the scenic amenity are addressed in **Section 4.2**.
The community values of places and landscapes reflecting the community's history and identity are not detrimentally affected by development.	Impacts on the landscape character of the project area are discussed in **Section 4.2**.
Fitzroy Shire Council Planning Scheme	
Social elements	
The Shire's residential communities are preserved in character, well serviced, enjoy high levels of safety and amenity, able to accommodate growth and offer a range of housing options to meet the diverse needs of all members of the community.	Health and safety impacts on the community are addressed in **Section 4.11** and impacts on the amenity are addressed in **Section 4.2**.

Desired Environmental Outcome (DEO)	Comment
Communities of Bouldercombe, Bajool, Marmor, Kabra, Stanwell, Westwood, Gogango, Alton Downs and Ridgelands have access to facilities and services that meet local needs, and where appropriate also provide some higher order services and functions important to the Shire.	The project will not impact upon access to community services during construction and operation of the project as discussed in **Section 4.10**.
Development is located and managed where ever possible to ensure the long term protection and conservation of the significant cultural heritage values of the Shire.	The long term protection and conservation of the cultural heritage and values is addressed in **Section 4.9**.
The risks to persons and property due to flood, bushfire and landslide are minimised.	Risks to persons and property from flood, bushfire and landslides are assessed in **Section 4.13**.
Environmental elements	
Sustainable measures for the use of the Shire's water resources including the Fitzroy River system, are implemented to ensure the provision of an adequate water supply and ongoing water quality.	The impacts on the Shire's water resources to ensure adequate provision of water supply and water quality are assessed in **Section 4.5**.
The potential downstream impacts of development, are minimised so as to reduce risks to the Great Barrier Reef catchment, which drains into the Great Barrier Reef World Heritage Area.	Impacts on the Great Barrier Reef catchment are assessed in **Section 4.8**.
Existing and planned water resources, including watercourses, water bodies, groundwater and tidal wetlands are managed and protected against the detrimental impacts of development.	The impacts on the Shire's water resources are assessed in **Section 4.5**.
The recognised values and integrity of significant natural features, conservation areas and open space networks eg. Conservation Parks, National Parks, native forests, are protected.	The values and integrity of natural features is assessed in **Section 4.8**.
The biodiversity and scenic values of native vegetation, which accommodates sensitive fauna and flora habitats, are protected.	Potential impacts on the biodiversity and scenic values of native vegetation are assessed in **Section 4.8**.
Development is located and managed to ensure the long term protection and conservation of the significant cultural heritage values of the Shire.	The long-tem protection and conservation of cultural heritage values is assessed in **Section 4.9**.
Public health and the environment are protected from environmental harm from waste and contaminated land. Efficient resource use and waste minimisation and management are promoted whilst allowing for ecologically sustainable development.	Public health and environment impacts from waste and contaminated land area assessed in **Section 4.4** and **Section 4.2**.
Air quality is maintained or enhanced whilst allowing for ecologically sustainable development.	Air emissions will be temporary during construction. No air emissions are anticipated during operation, and air quality will be maintained. Potential air quality impacts are assessed in **Section 4.6**.

Desired Environmental Outcome (DEO)	Comment
The quality of the acoustic environment is maintained or enhanced whilst allowing for ecologically sustainable development.	Noise and vibration emissions will be temporary during construction. Potential impacts associated with the acoustic environment are assessed in **Section 4.7**.
The spread or increase of weeds and pest animals is prevented.	The impacts and mitigation measures associated with the spread of weeds, pests and animals are addressed in **Section 4.8**.
Economic elements	
Port Alma remains an important port and industrial node in the Shire through ensuring adjoining land and vital transport routes are managed by the Planning Scheme to protect against the encroachment of incompatible land uses.	Potential impacts on Port Alma (within the Port of Gladstone) are assessed in **Section 4.12**.
Resources and areas of economic value, such as Good Quality Agricultural Land, extractive materials, and forestry, are not compromised.	Potential impacts and mitigation measures associated with the economic value of good agricultural land are addressed in **Section 4.2**.
The efficiency of infrastructure, including telecommunication, electricity transmission and distribution networks, and transport networks, is maintained and future extensions are well maintained.	The efficiency of infrastructure, except transport networks, will be maintained during construction and operation. Potential impacts on the infrastructure together with relevant mitigation measures are addressed in **Section 3.4**.
Water, sewer and stormwater infrastructure is planned and provided in a cost effective and timely manner to meet the needs of the Shire.	Potential impacts on the infrastructure together with relevant mitigation measures are addressed in **Section 4.2**.
Waste disposal facilities which are adequate for the Shire‘s needs, are maintained and protected from the encroachment of inappropriate land uses.	Waste disposal and appropriate measures are assessed in **Section 4.4**.
Calliope Shire Council Planning Scheme	
Environmental and conservation	
The desired environmental outcome being sought for the environment and conservation is to ensure development does not adversely affect the shire‘s natural environment. In particular the environment and conservation desired environmental outcome is to be achieved via the protection, maintenance and enhancement, as appropriate.	Potential impacts on the natural environment are assessment in **Section 4.8**.
(i) natural landscape and environmental features of the shire which include national parks, state forests, undeveloped coast, coastal and offshore islands, the timbered hills of the Calliope range, the riparian corridors of Raglan Creek and the Boyne and Calliope Rivers and their major tributaries as well as the waters of coastal and offshore islands, The Narrows, Boyne River, Calliope River and Raglan Creek;	Potential impacts on natural landscapes and their environmental features are assessed in **Section 4.8** and **Section 4.2**.

Desired Environmental Outcome (DEO)	Comment
ii) the Great Barrier Reef Marine Park and the Great Barrier Reef World Heritage Area;	Potential impacts on the Great Barrier Reef Marine park and World Heritage Area are assessed in **Section 4.5**.
(iii) ecological processes and habitat values of natural resources such as through the regeneration of bushland, retention of vegetated ridgelines and riparian corridors and management of water quality in the Shire's wetlands and waterways;	Potential impacts on ecological processes and the habitat values of natural resources is assessed in **Section 4.8**.
(iv) air and water resources for their health and amenity implications and clean air for its greenhouse implications;	Potential air quality impacts are assessed in **Section 4.5**. Potential impacts on water resources are assessed in **Section 4.6**.
(v) sites of cultural heritage significance of indigenous and non indigenous origin including built forms, vegetation and landscape, for their cultural importance to the community, the shire's past and its history of development;	The impacts on sites of cultural heritage significance including indigenous and non-indigenous areas are discussed in **Section 4.9**.
(vi) improved efficiencies in design and construction in order to meet desired greenhouse emission targets; and	The potential impacts associated with desired greenhouse emissions are discussed in **Section 4.1** and **Section 4.6**.
(vii) identification and management of acid sulfate soil in order to avoid the adverse effects on buildings and other infrastructure from acid sulfate soil disturbance.	The impacts on buildings and other infrastructure associated with acid sulphate soils are discussed in **Section 4.2**.
Economic development	
The desired environmental outcome being sought for economic development is to protect and broaden the economic base. In particular, the economic development desired environmental outcome is to be achieved through:	The impacts associated with economic development are discussed in **Section 4.12**.
(i) protection and enhancement of the productivity of the rural areas of the shire and good quality agricultural land;	The protection and enhancement of the productivity of rural areas is assessed in **Section 4.2** and **Section 4.12**.
(ii) protection of major industries and infrastructure, extractive and mineral resources and key local industries from activities which may impact on their ongoing operations and expansion and infrastructure needs;	The protection of major infrastructure and key industries from the proposed development is addressed in **Section 4.2** and **Section 4.12**.
(iv) provision and maintenance of a sustainable transport network, sea port, support industries and commercial services, in appropriate locations, for the GSDA the Gladstone Port and other major industrial enterprises;	The maintenance of the transport network and the impact from the development on the network is assessed in **Section 4.3**.
(viii) the facilitation of high standards for all development including design quality, infrastructure, resource efficiency, environment performance, landscape setting, amenity, access to social infrastructure and convenience services	The facilitation of high standards for the development is outlined in **Chapter 3**, **Section 4.2**, **Section 4.10** and **Section 4.13**.

Desired Environmental Outcome (DEO)	Comment
Development patterns and infrastructure	
The overall desired environmental outcomes sought for development patterns and infrastructure is to clearly define the major industry and major infrastructure, industrial, commercial, residential, and open space areas. In particular, the development patterns and infrastructure desired environmental outcome is to be achieved through: (i) consolidation of land uses with similar infrastructure needs into those areas able to be serviced easily and economically and designed to integrate and enhance the full potential of infrastructure and services;	Land use impacts and impacts on the infrastructure in the project area are assessed in **Section 4.2** and **Section 4.12**.
(iv) funding the delivery of development infrastructure which does not entail inequitable or unreasonable cost burdens to the Shire;	Potential impacts on the economy and appropriate mitigation measures are assessed in **Section 4.12**.
(v) meeting the outcomes of the Curtis Coast Regional Coastal Management Plan for settlement pattern and design, for land use within the erosion prone area and for land use within and adjacent to areas of State significance and important habitat areas.	Potential land use impacts are assessed in **Section 4.2**.
Community development	
The desired environmental outcome sought for community development is that Calliope Shire will be an equitable, sustainable and prosperous community characterised by a strong local community focus. In particular, the community development desired environmental outcome is to be achieved through:	Potential impacts on the community are assessed in **Section 4.10**.
(ii) a wide range of satisfying and rewarding employment opportunities;	Employment opportunities as a result of the proposed development are assessed in **Section 4.12**.
(iii) convenient access to a range of community facilities and services including health care, education, shopping and business services, cultural and entertainment facilities, and recreation and sporting facilities;	Community facilities and services will not be affected by the project during construction of operation. Community related health and safety impacts are assessed in **Section 4.11**.
(iv) the recognition and maintenance of cultural heritage values;	The recognition and maintenance of cultural heritage values are assessed in **Section 4.9**.
(v) a high level of mobility through an efficient and viable transport network;	The transport network will be temporarily affected during the construction of the project. The maintenance of an efficient and viable transport network is addressed in **Section 4.3**.
(vi) a clean, safe environment where the risk of flood, bushfire and landslide is minimised; and	Risks to the environment from flood, bushfire, and landslides are assessed in **Section 4.13**.

Desired Environmental Outcome (DEO)	Comment
(vii) a landscape which maximises the natural attributes of the shire comprised of regional landscapes, the foreshores, the ridgelines and native bushland, and the waterways for the enjoyment of the residents and visitors.	Landscape character and amenity impacts are assessed in **Section 4.2**.

Local laws

Local laws are adopted by local councils and reflect community need and ensure the good rule and government of the area. Through local laws, local councils can establish permit or licence regimes for non-development activities to create offences for unacceptable behavior and to allow for the issue of compliance or abatement notices. There are four types of local laws including:

- Model local laws;
- Interim local laws;
- Subordinate local laws; and
- Other local laws.

Local laws that would usually be applicable to assessable development, relating to the construction and operation of the project and associated incidental activities include local laws on roads, temporary homes, blasting operations, control of pests, signs and advertisements, water supply, tree preservation and parks and reserves.

1.5.1.4. List of approvals

A list of anticipated project approvals and permits, following the EIS, has been developed in accordance with the requirements under Commonwealth, state and local legislation. The list of approvals is included at **Appendix A2**, **Volume 3**.

1.5.2. PLANNING PROCESSES AND STANDARDS

This section outlines the long term policy framework for the project as reflected in state policies (including offset policies and State Planning Policies (SPPs)), regional plans and Natural Resource Management (NRM) plans. Overall, the project is consistent with the existing land uses and long term policy framework of the areas located along the proposed pipeline route. Refer to **Section 4.2**.

All standards and codes applicable to the project are outlined in the relevant sections of the EIS. The main standard applicable for the project is AS 2885 and the main code is the Australian Pipeline Industry Association (APIA) *Code of Environmental Practice – Onshore*

Pipelines (APIA, 2009). The pipeline will be constructed in accordance with these and the EMP prepared for the project (**Chapter 5**) mirrors the APIA Code.

1.5.2.1. Queensland Government Environmental Offset Policy

The Queensland Government Environmental Offset Policy (QGEOP) provides a framework for environmental offsets in Queensland including principles and guidelines for using environmental offsets and guidance on when offsets should and should not be considered.

Environmental offsets are used to replace the value of environmental features inevitably lost during development. However, offsets should only be considered after all environmental impacts have been avoided and minimised and if all other government environmental standards have been met. An offset may be located within or outside the geographic site of the impact.

The QGEOP guides the appropriate use of environmental offsets across terrestrial and aquatic ecosystems, based on the principles of ESD. An example is offsetting vegetation loss by undertaking ongoing management actions near the impact site to increase the quality and extent of vegetation.

Vegetation clearing required for the project is identified in **Section 4.8** including the required environmental offsets. An offset management plan will be developed and will incorporate the principles of ESD.

1.5.2.2. Policy for Vegetation Management Offsets

The *Policy for Vegetation Management Offsets – Version 2* (Offsets Policy) sets out the required characteristics for offset suitability under the VM Act. The Chief Executive must comply with the Offsets Policy when imposing an offset as a condition of a development approval.

For offsets to be eligible they must be in accordance with the policy, that is, be located on land that are category X areas on a PMAV, unrestricted regrowth vegetation or other regrowth. Offsets must also be of ecological equivalence to the proposed clearing sites and maintain or improve the ecological values and REs.

Offsets may be delivered as land-based offsets or offset payments:

- Land-based offsets involve the acquisition, rehabilitation and legal securing of a suitable area of land to compensate for the impacts of a proposed development. Land-based offsets may be a direct offset proposed by the applicant, or an offset transfer negotiated with an offset broker. A land-based offset may also incorporate an indirect offset if the proposed offset area cannot achieve ecological equivalence with the impact site. Indirect offsets must be an activity approved by DERM, such as improvements in ecological knowledge or management of protected species and communities; and

- Offset payments are financial payments to Ecofund Queensland, which will be used to purchase or secure land containing significant State biodiversity values. Offset payments cannot be accepted for impacts to EVNT species, critically limited REs and threshold REs. The policy provides a method to calculate the required offset payment, which incorporates management and administration costs.

Refer to **Appendix A4.3**, **Volume 3** for further information on offsets under this policy.

1.5.2.3. Draft Queensland Policy for Biodiversity Offsets

The draft Queensland Policy for Biodiversity Offsets aims to protect a variety of valued biodiversity assets for which there has previously been no formal requirement to offset impacts. Such values include the Protected Area Estate, remnant vegetation not protected by the VM Act, EVNT, wetlands of high conservation value and other significant ecosystem values such as bioregional corridors.

Biodiversity offset requirements are similar to those described above for the Queensland Offsets Policy, including offset delivery methods, legal securing of offsets, suitability of offset sites and offset management planning. The applicability of this offset policy to the project is discussed further in **Appendix A4.3**, **Volume 3**.

1.5.2.4. State Planning Policies

State Planning Policies (SPPs) are statutory instruments that the planning Minister uses to protect various aspects of the environment that are of interest to the state (e.g. agricultural land, development within close proximity to airport land, protecting development from adverse affects of bushfire, floods and landslides).

Under the Coastal Act (**Section 1.5.1.2**), the State Coastal Plan and Regional Coastal Management Plans have the status of SPPs for the purpose of drafting planning schemes.

The SP Act provides that any development application lodged with an assessment manager under the SP Act needs to include an assessment of any applicable SPPs. If SPPs are found to be appropriately reflected in the applicable local government planning scheme, then this assessment may occur through assessing compliance with applicable codes within the planning scheme.

SPPs applicable to the project, their purpose and whether they are appropriately reflected in the relevant planning scheme is outlined in **Table 1-11**.

Table 1-11: State Planning Policies applicable to the project

State Planning Policy	Purpose	Reflected in Planning Scheme	Comments
SPP 1/92 *Development and Conservation of Agricultural Land*	SPP 1/92 seeks to protect good quality agricultural land (GQAL) from development that diminishes its productivity or leads to its alienation.	Yes	The project will not alienate any GQAL as any land disturbed as a result of construction will be reinstated back to its original condition (refer to **Section 4.2**).
SPP 1/03 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*	The purpose of this SPP is to set out the State government's interest with regard to natural hazards of flood, bushfire and landslide to ensure these matters are adequately addressed when carrying out development assessment. The SPP applies throughout Queensland to each LGA listed in Annex 2 of the SPP. The LGAs traversed by the proposed pipeline route are included in Annex 2.	Yes	The design of the proposed pipeline is in accordance with AS 2885 and takes into account the potential impacts of natural hazards. None of the aspects within SPP 1/03 will significantly affect the land use of the project area. The impacts of flood, bushfire and landslide are further discussed in **Section 4.13**.
SPP 2/02 *Planning and Managing Development Involving Acid Sulfate Soils*	This SPP applies to areas of Queensland when excavating 100 m^3 of soil or filling 500 m^3 of land at or below 5 m Australian Height Datum (AHD) where the natural ground level is less than 20 m AHD.	Yes	The impact of the project on acid sulfate soils is discussed in **Section 4.2**. The management of acid sulfate soils associated with the project is provided in the EMP (**Chapter 5**) and will be undertaken in accordance with the SPP 2/02 Guideline.
Curtis Coast Regional Coastal Management Plan (Curtis Coastal Plan)	This Plan has the effect of an SPP as the proposed pipeline route crosses land included within this Plan. The Plan identities coastal resource and management issued for the Curtis Coast.	Yes	An assessment of the project against the management outcomes of the Curtis Coastal Plan has been provided in **Section 1.5.2.6**.

State Planning Policy	Purpose	Reflected in Planning Scheme	Comments
Draft SPP for Coastal Protection (to take effect sometime in 2011)	This SPP contains policies, criteria and maps, and is directed at planning and development outcomes in the coastal zone. The coastal policy address: ▪ Buildings and structures in erosion prone areas; ▪ Protection and conservation of ecological values, including areas of high ecological significance; ▪ Maintaining physical coastal processes; ▪ Preserving scenic amenity on the coast; ▪ Maintaining public access to the coast.	N/A New planning schemes (developed by each local government as a result of the amalgamations) will need to have regard to this SPP.	The construction of the proposed pipeline route in erosion prone areas has been addressed in **Section 4.2.2.4**. The protection of ecological values, including where the project traverses areas of high ecological significance has been addressed in **Section 4.8**. The physical coastal processes, scenic amenity and public access would not be affected during operation of the pipeline as it is located underground. During construction, physical coastal processes would not be affected as waterways in coastal areas (namely Raglan Creek) would be subject to HDD. There would be temporary visual amenity impacts, as addressed in **Section 4.2.2.6**.
SPP *Protection of Queensland's Strategic Cropping Land*	Under this SPP, Annex 2 identifies that constructing underground pipelines only has a temporary impact on Strategic Cropping Land (SCL) so long as SCL can be restored to its original condition.	N/A New planning schemes (developed by each local government as a result of the amalgamations) will need to have regard to this SPP.	The proposed pipeline route will be underground and land will be restored to its original condition.

1.5.2.5. Strategic Cropping Land Bill 2011

On 25 October 2011, the Queensland government introduced the *Strategic Cropping Land Bill 2011* into Parliament which is an Bill about land that is highly suitable for cropping. The Bill is intended to be enacted in early 2012 and aims to:

- Protect land that is identified as being highly suitable for cropping;
- Manage the impacts of development and petroleum activities on land identified as suitable for cropping land; and
- By limiting development and activities able to occur on the land, preserve the productive capacity of that land for future generations.

The Act will require proposed development that may impact on Queensland's best cropping land to be assessed to ensure it does not cause permanent damage. It is proposed that developments such as CSG, underground coal gasification, mining and urban uses will be subject to this new legislation.

It is intended that the Strategic Cropping Land Act, once passed, will be supported by a SPP, *Protection of Queensland's Strategic Cropping Land*. A draft of this SPP was released in August 2011[2] for public comment. Under the draft SPP, Annex 2 identifies that constructing underground pipelines only have a temporary impact on areas of SCL so long as impacted SCL can be restored to its original condition. Development considered to have a temporary impact on areas of SCL are required to address ‗Code B' of Annex 3 to demonstrate compliance with the outcomes of the draft SPP.

1.5.2.6. Regional plans

The project is subject to three regional plans, namely:

- The *Draft Mackay, Isaac, Whitsunday Regional Plan* (Draft MIW Regional Plan);
- The *Central Queensland Regional Plan* (Central Queensland Regional Growth Management Framework); and
- The *Curtis Coast Regional Management Plan* (Curtis Coastal Plan).

Draft MIW Regional Plan

The Draft MIW Regional Plan encompasses the local government areas of Isaac, Mackay and Whitsunday. The region is located on the Central Queensland coast and extends west to the Central Highlands. The region is a significant growth area, having one of the fastest growing economies in the state. The main contributing industries in the region are mining, agriculture and tourism. The Draft MIW Regional Plan takes precedence over all planning instruments, other than state planning regulatory provisions.

The effect of the MIW Regional Plan is established under Chapter 2, Part 3, Division 2, Subdivision 1 of the SP Act. For the purposes of the project the MIW Regional Plan is a statutory instrument under the *Statutory Instruments Act 1992*. The Draft MIW Regional Plan outlines eight desired regional outcomes which are supported by a range of principles, policies and programs. These desired regional outcomes for which the project would have regard to include:

- Sustainability and climate change;
- Natural environment and regional landscapes;

[2] Note: once a draft planning document is released for public comments, it is given weight by the planning and environment court in making decisions.

- Natural resources;
- Economic development;
- Strong communities;
- Settlement pattern;
- Integrated transport; and
- Infrastructure.

An assessment of the project against each of the above desired regional outcomes is provided in **Table 1-12**.

Table 1-12: Desired regional outcomes for the draft Mackay, Isaac, Whitsunday Regional Plan

Desired regional outcome category	Desired regional outcome	Comment
Sustainability and climate change - sustainability	Integrate ecological sustainability indicators into decision-making and management processes to ensure ecologically sustainable outcomes.	The proposed pipeline route has been developed to avoid areas of high ecological significance, where possible. Management measures have been developed to mitigate impacts on ecology (refer to **Section 4.8.2**).
Sustainability and climate change - sustainability	All decision-making processes comply with the Queensland Government framework for ecologically sustainable development.	Arrow has applied the principles of ESD in the project planning process and in selecting the most appropriate alternatives for the proposed pipeline. This is further detailed in **Section 2.1.1**.
Sustainability and climate change - climate change	Reduce greenhouse gas emissions from development, land management and other planning decisions in the region.	Mitigation measures to reduce greenhouse gas emissions during construction and operation of the project have been identified in the EIS (refer to **Section 4.6.2.1**).
Sustainability and climate change - natural hazards	Reduce the risk of natural hazards, including the projected effects of climate change, by avoiding areas of high exposure and establishing adaptation strategies to minimise vulnerability to riverine flooding, storm, tide and sea level rise inundation, coastal erosion, bushfire and landslides.	A climate change risk assessment and a risk mitigation strategy which includes mitigation and adaptation options for climate change have been prepared for the project (refer to **Section 4.1** and **Section 4.13**).

Desired regional outcome category	Desired regional outcome	Comment
Sustainability and climate change - natural hazards	Reduce the risk of natural hazards, including the projected effects of climate change, by establishing adaptation strategies to minimise vulnerability to heatwaves and higher temperatures, reduced and more variable rainfall, tropical cyclones, hail, and severe storms and winds.	A climate change risk assessment and a risk mitigation strategy which includes mitigation and adaptation options for climate change has been prepared for the project (refer to **Section 4.1** and **Section 4.13**).
Sustainability and climate change - natural hazards	Ensure planning and development decisions consider the impact of flood, bushfire, landslip and coastal hazards, including a range of potential sea level rises.	Natural hazards have been considered as part of hazard and risk in **Section 4.13**.
Natural environment and regional landscapes - biodiversity	Ensure urban development is located, designed and operated to avoid impacts on areas of high ecological and biodiversity value, including corridors.	The proposed pipeline route has been developed to avoid areas of high ecological and biodiversity value, where possible.
Natural environment and regional landscapes - biodiversity	Where offsets for environmental impacts are required, offset policies should align with applicable offset policies developed under the *Queensland Government Environmental Offsets Policy 2008*.	Offsets will be provided where required and will be in accordance with the *Queensland Government Environmental Offsets Policy* (refer to **Section 4.8**).
Natural environment and regional landscapes - watercourses and wetlands	Protect, manage and rehabilitate riparian areas to maintain and enhance their water quality, and scenic, biodiversity, ecological, outdoor recreation and corridor values.	The pipeline route crosses multiple riparian areas. These areas will be rehabilitated after the completion of construction.
Natural environment and regional landscapes - watercourses and wetlands	Identify and manage areas with a high probability of acid sulfate soils (ASS).	The proposed pipeline route traverses land that has no known occurrence of ASS or low probability of ASS for almost the entire length of the route. There may be some soils classed as high probability for presence of ASS or potential acid sulfate soils (PASS) in the low lying areas of Bajool – Port Alma area. Management measures to address ASS are identified in **Section 4.2**.
Natural environment and regional landscapes - watercourses and wetlands	Identify and manage wetland areas of high ecological significance.	The proposed pipeline route crosses a number of wetland areas including those of high ecological significance which are identified in **Section 4.8**. Management measures have also been identified in **Section 4.8**.

Desired regional outcome category	Desired regional outcome	Comment
Natural environment and regional landscapes - watercourses and wetlands	Ensure that development is planned, designed, constructed and operated in accordance with best practice environmental management to protect environmental values and meet water quality objectives of all surface waters, groundwater, wetlands and coastal waters across the region.	Environmental values and objectives for water quality in relation to the project are addressed in **Section 4.5** including surface waters, groundwater and wetlands. The project would be constructed and operated in accordance with best practice environmental management measures as outlined in the APIA Code of Practice.
Natural environment and regional landscapes - regional landscape values	Identify and protect regionally significant and locally important areas of scenic amenity, view corridors, and popular or significant viewpoints.	The landscape character of the project will be temporary affected during construction of the project (refer to **Section 4.2.1.8**). However, as the pipeline will be located underground, no impacts during operation are anticipated. Mitigation measures for landscape character are identified in **Section 4.2.2.5**.
Natural environment and regional landscapes - air and acoustic environment	Ensure development that generates air, noise and vibration emissions is adequately separated, planned, designed, constructed and operated to ensure that relevant emission standards are met.	Air and noise and vibration emissions will be temporary during construction. No air and noise and vibration emissions are anticipated during operation. Air emissions from the project have been discussed in **Section 4.6**, and noise and vibration emissions from the project have been discussed in **Section 4.7**.
Natural resources – primary production, land use and management	Protect the region's good quality agricultural land (GQAL) from incompatible uses that may compromise its long term use for agricultural purposes and apply appropriate buffers between urban residential development, agricultural operations, and other development.	The proposed pipeline route will be constructed in a 30 m ROW and extend to 2 m below ground surface therefore the potential impacts have been assessed with regard to possible degradation of GQAL. The disturbed area will be rehabilitated as quickly as possible using best practice methods, and the productivity of the impacted land will be returned, as near as is practicable, to its pre-disturbance levels (refer to **Section 4.2.2.1**).
Economic development – economic leadership	Create and strengthen links with domestic and international markets.	The project has been assessed as representing a major investment in Queensland and Australia and will contribute to the establishment of an export gas industry in Gladstone.
Economic development – economic leadership	Strengthen the region's economic position and promote its competitiveness advantage and assets.	The project will contribute to increased output in the region resulting in local and regional economic growth and an increased contribution to gross regional product (GRP) and gross state product (refer to **Section 4.12**).

Desired regional outcome category	Desired regional outcome	Comment
Economic development – resource sector	Manage mining and extractive resources to maximise economic opportunities, while minimising negative environmental and social impacts for present and future generations.	The economic impacts and benefits of the project have been assessed for all stages of the project. The environmental and social impacts for present and future generations have been considered throughout the whole of the EIS (refer to **Section 4.12**).
Strong communities – sustainable and resilient communities	Ensure temporary workers' accommodation is located appropriately within the settlement pattern and does not impact land which is used, or could in the future, for agricultural, industrial or other purposes.	The indicative locations of the temporary worker accommodation are described and shown in **Section 3.3.3**. Approval for the temporary workers' accommodation camp will be sought later in the planning and approval process under the IDAS. The land on which camps will be located will be returned to agricultural purposes on removal of the camp.
Strong communities – cultural heritage, arts and cultural development	Protect, manage and conserve Aboriginal and Torres Strait Islander cultural heritage including landscapes, places and objects.	Indigenous cultural heritage including management measures to minimise impacts on heritage has been considered (refer to **Section 4.9**).
Strong communities – cultural heritage, arts and cultural development	Protect, manage and conserve places of cultural heritage value to non-indigenous members of the community.	Non-indigenous cultural heritage including management measures to minimise impacts on heritage has been considered (refer to **Section 4.9**).
Strong communities – Engaging Aboriginal and Torres Strait Islander peoples	Consult with Traditional Owners and provide avenues for their interests to be recognised in development and planning, including identification and preservation of cultural heritage sites and landscapes.	As part of the project commitments, Arrow commits to collaborate and consult with Aboriginal parties to avoid sites of cultural heritage significance, where feasible, and develop a management program of all Aboriginal cultural heritage affected by the project.

Central Queensland Regional Plan

The Central Queensland Regional Plan encompasses the LGAs of Banana Shire Council, Central Highlands Regional Council, Gladstone Regional Council (excluding former Miriam Vale Shire Council) Rockhampton Regional Council and Woorabinda Aboriginal Shire Council. This regional plan was developed under the repealed IP Act and remains current under the SP Act. The Central Queensland Regional Plan is divided into six themes for which the project would have regard to including:

- Resource use, conservation and management;
- Economic development;

- Infrastructure;
- Social and cultural development;
- Education, training and research; and
- Planning and governance.

An assessment of the project against each theme is provided in **Table 1-13**.

Table 1-13: Themes for the Central Queensland Regional Plan

Theme category	Theme	Comment
Resource use, conservation and management – land use planning and management	Ensure the protection and conservation of the region's valuable natural resource assets.	The proposed pipeline route was developed to avoid areas of high ecological and biodiversity value, where possible. Where impacts exist to flora and fauna, these would be managed with appropriate mitigation measures (refer to **Section 4.8**).
Resource use, conservation and management – land use planning and management	Identify and recognise mining, petroleum and extractive resources, including hard rock quarry resources, and their economic potential, ensuring sites and access to them are protected from incompatible land uses, and impacts associated with their extraction are kept within socially and environmentally acceptable limits.	Current and existing land uses for the project is addressed in **Section 4.2**. The social and environmental impacts of the project have been considered throughout the EIS.
Resource use, conservation and management – water use planning and management	Protect and enhance water quality and the environmental values of the region's water ways.	Water quality, surface water and waterways during the construction and operation of the project have been considered (**Section 4.5**). Any potential impacts during construction have been addressed with proposed mitigation measures. The operation of the project is unlikely to affect water quality or waterways.
Resource use, conservation and management – biodiversity conservation	To protect and restore, where required, the diversity of landscapes, plants and animals in the region and the ecological processes essential for their continued existence.	The proposed pipeline route was developed to avoid areas of high ecological and biodiversity value, where possible. Where unavoidable impacts exist to flora and fauna, these would be managed with appropriate mitigation measures (refer to **Section 4.8**).
Economic development - Energy	Capitalise on energy resources, generation capacity and clustering opportunities of the region (Gladstone, Stanwell, and Biloela).	The project is an important component of capitalising on energy resources and generating capacity in the region.

Theme category	Theme	Comment
Social and cultural development – arts, culture and heritage	Protect and preserve the region's cultural heritage including archaeological, traditional, historic and contemporary cultural values.	Cultural heritage including management measures to minimise impacts on heritage has been considered for the project (refer to **Section 4.9**).

Curtis Coast Regional Coastal Management Plan

The Curtis Coast Regional Coastal Management Plan (Curtis Coastal Plan) describes how the coastal zone in the Curtis Coast region is to be managed within the policy framework established by the State Coastal Management Plan. The Curtis Coastal Plan applies to the coastal zone[3] and specifically sections of the project that traverse land within the Curtis Coastal Plan, where the proposed pipeline route crosses Raglan Creek.

The Curtis Coastal Plan addresses matters of international, national, state or regional importance within the region. Implementation of the Curtis Coastal Plan is a key mechanism for achieving the purpose of the State Coastal Management Plan which provides direction and guidance based on:

- Coastal use and development;
- Physical coastal processes;
- Public access to the coast;
- Water quality;
- Indigenous Traditional Owner cultural resources;
- Cultural heritage;
- Coastal landscapes;
- Conserving nature;
- Coordinated management; and
- Research and information.

The Curtis Coastal Plan includes a number of regional policies which guide development in the coastal zone. An assessment of the project (where the project is within the Curtis Coastal Plan) against the key regional policies of the Curtis Coastal Plan is provided in **Table 1-14**.

[3] The coastal zone refers to coastal waters and all areas to the landward side of coastal waters in which there are physical features, ecological or natural processes or human activities that affect, or potentially affect, the coast or coastal resources (DERM, 2011).

Table 1-14: Regional policies of the Curtis Coastal Plan

Regional policy	Coastal management outcome	Comment
Coastal use and development	Use and development of the coastal zone occurs in an ecologically sustainable manner.	Arrow has applied the principles of ESD in the project planning process and in selecting the most appropriate alternatives for the proposed pipeline route (refer to **Section 2.1.1**).
Physical coastal processes	The coast is managed to allow for natural fluctuations to occur, including any that occur as a result of climate change and sea level rise, and provide protection for life and property.	Climate change and sea level rise has been considered for the project. The project will have limited vulnerability to climate change during operation (refer to **Section 4.1**).
Public access to the coast	Opportunities for public access to the coast are maintained and enhanced, consistent with the conservation of coastal resources and provision of public safety.	Public access to the ROW will be temporarily affected during the construction of the pipeline, with regards to the provision of public safety. Public access across the pipeline would be maintained during operation.
Water quality	Water quality in the coastal zone is maintained at a standard that protects and maintains coastal ecosystems and their ability to support human use.	Pipeline construction activities have the potential to affect water quality in the vicinity of watercourse crossings. Mitigation measures for water quality have been included (refer to **Section 4.5**).
Indigenous Traditional Owner cultural resources	The living culture of Indigenous Traditional Owners and their connection with cultural resources within the coastal zone is valued and continues for future generations of Indigenous Traditional Owners.	Aboriginal parties will be consulted to avoid areas of cultural heritage significance where feasible and to develop a management program for cultural heritage (refer to **Section 4.9**).
Cultural heritage	Places, buildings and objects with important cultural heritage values located on the coast are appreciated, conserved, managed and passed on to future generations.	A cultural heritage impact assessment and draft Historical Heritage Management Plan been prepared for the project to manage potential impacts of the project on cultural heritage items (refer to **Appendix A4.15**, **Volume 3**).
Coastal landscapes	The scenic and cultural values associated with coastal landscapes are protected.	The construction of the project may result in temporary scenic visual impacts (refer to **Section 4.2.2.6**). Potential impacts on cultural values have been addressed in **Section 4.9**. No impacts during operation of the project on scenic and cultural values are anticipated.

Regional policy	Coastal management outcome	Comment
Conserving nature	Coastal ecosystems, including their ecological processes, opportunities for survival, biological diversity and potential for continuing evolutionary adaption, are maintained, enhanced and restored.	Coastal ecosystems will be maintained as where the proposed pipeline route crossed Raglan Creek, which is located in the coastal area, it will be HDD (subject to geotechnical investigations). No impacts to coastal ecosystems are anticipated during operation.
Coordinated management	Coastal management is coordinated and integrated across all levels of government and within the community.	This policy is not relevant to the project.
Research and information	Research programs, and data and information collection and management focus on, support and enhance effective coastal management.	This policy is not relevant to the project.

1.5.2.7. Natural Resource Management Plans

The project is located within two Regional Natural Resource Management bodies (Regional NRM bodies), these being the North Queensland Dry Tropics (Land and Water Solutions) (NQ Dry Tropics) and Fitzroy Basin Association Inc (FBA).

The major task for the Regional NRM bodies is to develop, review and coordinate the implementation of a Natural Resource Management Plan (NRM Plan) for their region. Although non-statutory, NRM Plans set out the means for identifying and achieving natural resource management targets that are agreed by government and the community. They detail catchment-wide activities addressing a range of natural resource management issues including land and water management, biodiversity and agricultural practices. The FBA has developed a NRM Plan for their region, the *Central Queensland Strategy for Sustainability – 2004 and Beyond* (CQSS2). NQ Dry Tropics is yet to develop an NRM Plan for their region.

Central Queensland Strategy for Sustainability – 2004 and Beyond

The Central Queensland region covers an area in excess of 156,000 km^2, with a population of about 200,000 people and containing abundant natural and cultural assets. The CQSS2 is a second iteration of the *Central Queensland Strategy for Sustainability* (CQSS), seeking to protect the region's assets through addressing key pressures. The CQSS2 aims to:

- Provide a framework for achieving continuous improvement towards the sustainable use of natural resources and the protection of the natural environment in Central Queensland;
- Encourage the active participation of all stakeholders in natural resource and environmental planning, decision-making and management; and

- Guide investment in natural resource and environmental management in Central Queensland.

The CQSS2 identifies critical assets for protection and has established resource conditions and management action targets to address key pressures on regional assets. Regional assets include, among others, land, soil, water, weeds and pests, fire, climate change, air quality, mining, forest practices, ecosystems and biodiversity, coasts and marine habitat. The CQSS2 identifies the groups and organisations with lead roles and responsibilities in implementing management action targets, such as local governments, private sector providers, Queensland state agencies, Landcare, etc. The region‘s assets identified in the CQSS2 can be protected through consultation with these groups and organisations during construction and operation of the pipeline.

1.5.2.8. Climate change policies

Climate change is guided by the *National Climate Change Adaption Framework* and the *ClimateQ: toward a greener Queensland* (Office of Climate Change initiative). The *National Climate Change Adaption Framework* provides guides and tools to assist decision-makers in managing climate change impacts, while the *ClimateQ: toward a greener Queensland* forms Queensland‘s response to the challenge of climate change. It presents investments and policies to ensure Queensland remains at the forefront of the national climate change response.

1.6. ACCREDITED PROCESS FOR CONTROLLED ACTIONS UNDER COMMONWEALTH LEGISLATION

On February 2011, an application was made by Arrow under Section 71 of the EP Act for the preparation of a voluntary EIS. This application was deemed valid as of 4 March 2011 after the receipt of further information.

The project has not yet been referred to the DSEWPAC to determine if it will be a controlled action under the EPBC Act. Consequently, the processing of the EIS under Queensland State legislation is not intended to act as an assessment for the EPBC Act purposes under the Bilateral Agreement between the Commonwealth of Australia and the State of Queensland (refer to **Section 1.5.1.1**).

2. PROJECT NEED AND ALTERNATIVES

2.1. PROJECT JUSTIFICATION

This section provides justification for the project in a regional, state and national context with particular reference to the principles of ESD and the environmental, economic and social benefits of the project.

2.1.1. ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Australia's *National Strategy for Ecologically Sustainable Development (1992)* (National Strategy for ESD) defines ESD as ―*using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future can be increased*" (Commonwealth of Australia, 2011). It describes challenges, strategic approaches and objectives for achieving ESD as well as a number of inter-sectoral issues for developments, many of which are relevant to the project.

The two main features which distinguish an ecologically-sustainable approach to development (Commonwealth of Australia, 2011) are:

- Considering, in an integrated sense, the wider environmental, economic and social implications of decisions and actions for Australia, the international community and the biosphere; and
- Taking a long term rather than short term view on environmental, economic and social decisions and actions.

The National Strategy for ESD includes a number of goals, core objectives and guiding principles for ESD as shown in **Table 2-1**.

Table 2-1: National Strategy ESD goals, core objectives and guiding principles

Goal	Core Objective	Guiding Principles
Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.	▪ To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations. ▪ To provide for equity within and between generations. ▪ To protect biological diversity and maintain essential ecological processes and life-support systems.	▪ Decision-making processes should effectively integrate both long and short term economic, environmental, social and equity considerations. ▪ Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. ▪ The global dimension of environmental impacts of actions and policies should be recognised and considered.

Goal	Core Objective	Guiding Principles
		▪ The need to develop strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised. ▪ The need to maintain and enhance international competitiveness in an environmentally-sound manner should be recognised. ▪ Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms. ▪ Decisions and actions should provide for broad community involvement on issues which affect them.

Arrow has applied the principles of ESD in the project planning process and in selecting the most appropriate alternatives for the proposed pipeline route. Specifically the project planning process has included the following considerations:

- Both long term and short term environmental, economic and social and equity considerations (**Section 2.1.2**);
- Environmental damage. Construction and operation will not pose threats of serious or irreversible environmental damage and measures will be undertaken during each phase of the project to ensure environmental degradation is prevented (**Section 4.8**);
- Environmental policies in planning and design (**Section 1.5.1** and **Section 1.5.2**);
- Enhance the national, state and local economy (**Section 4.12**);
- Enhance international competitiveness in an environmentally-sound manner;
- Cost-effective and flexible policy instruments such as valuation, pricing and incentive mechanisms; and
- Community and stakeholder engagement and consultation (**Section 1.4**, **Section 4.9** and the *Social Impact Assessment* in **Appendix A4.2**, **Volume 3**).

The principles of ESD in relation to the project are outlined in more detail in **Appendix A3**, **Volume 3** of the EIS.

2.1.2. PROJECT BENEFITS

Overall, the project has been assessed as representing a major investment in Queensland and Australia and will contribute to the establishment of an export gas industry in Gladstone. *"The LNG industry provides Queensland with an existing opportunity to create new jobs in our regional centres, affected by the recent downturn in resource exports and increases the potential prosperity of all Queenslanders through greater export revenue and royalty payments*" (DEEDI, 2011).

The project forms a key link in Arrow Energy's long term strategy of creating a CSG north to south pipeline network connecting Arrow Energy's gas fields in the Surat and Bowen Basins to their customers and power stations at Daandine and Braemar, the proposed Arrow LNG Plant on Curtis Island, and through a connection to be developed in the future, to customers in Moranbah as well as customers and the power station at Townsville.

Arrow is committed to managing project specific impacts at a regional and local scale. The project has undergone rigorous environmental, economic, social and economic assessments for all stages of the project. Each assessment describes the environmental, economic and social values of the project, identifies impacts on such values and proposes mitigation measures (refer to the relevant sections of the EIS).

The benefits from the project are cumulative and can be considered in conjunction with Arrow Energy's other CSG and LNG related projects (refer to **Chapter 1** for a list of other related projects).

The project is expected to provide a number of economic benefits to the Mackay and Fitzroy regions including:

- Contribution to increased output in the project area resulting in local and regional economic growth;
- Contribution to increased household income through potential increase in consumption and potential increase in savings and investment;
- Contribution to employment, particularly in construction;
- Generate a total project income benefit of $128 million in the project area; and
- Indirectly inject close to $2.9 billion into the Australian economy with one fifth of the total output impact is expected to accrue to the project area.

The economic impacts of the project are discussed further in **Section 4.12**, and in the *Economic Assessment*, **Appendix A4.1**, **Volume 3**.

The project's contribution to creating more jobs and a stronger economy will have flow on effects for the local community and provide a number of social benefits to the Mackay and Fitzroy regions including:

- Opportunity for local businesses to supply goods and services to the project such as for catering and food services, transportation, sub-consultant construction skills and accommodation services;
- Where appropriate, an opportunity to source workers locally, either directly for the project or indirectly through goods and services providers. This would especially benefit locations within the project area with high unemployment rates as well as marginal groups such as youth and indigenous people and would maximise the economic benefits of the project for local communities; and
- Opportunities for existing employees to develop additional skills and undertake training during all phases of the project. These skills can be transferred to future projects in the mining and gas industry thereby providing a long term benefit to the region.

The social impacts of the project are further assessed in **Section 4.9** and the *Social Impact Assessment* included in **Appendix A4.2**, **Volume 3**.

When completed, the project will produce many short and longer term benefits including:

- Adding strength and diversity to Queensland's economic base and providing significant royalty and other revenue for the Queensland and Australian governments;
- Assisting in insulating the Australian and Queensland economies against adverse international trends;
- Supporting further development of LNG export markets at a time when energy supply is in deficit and a continued growth in global demand is anticipated;
- Strengthening Queensland's position as leaders in CSG development in Australia and globally; and
- Providing Queensland with the opportunity to look for ‗green' energy sources to replace coal fired electricity generation.

2.2. ALTERNATIVES TO THE PROJECT

There are a number of potential alternatives associated with the project and selection options, including:

- Development of the CQP;
- Not developing the project;
- Alternative pipeline route options; and

- Changes to project design, construction techniques and environmental impact mitigation measures.

A discussion of each alternative is as follows.

2.2.1. DEVELOPMENT OF THE CENTRAL QUEENSLAND GAS PIPELINE

Arrow Energy is currently a 50/50 joint venture holder with AGL Energy Ltd, the proponent for the proposed CQP (PPL121). The CQP involves the construction and operation of a 440 km long high pressure gas transmission pipeline from Moranbah to Gladstone in Central Queensland. The CQP, if developed, will provide a strategic link for gas supply between north Bowen Basin and Gladstone. The CQP is, however. inadequate to transfer sufficient CSG to the proposed Arrow LNG Plant on Curtis Island and is no longer considered suitable as a transmission pipeline for CSG from Arrow Energy's tenements in the Bowen Basin having regard to the following:

- The design capacity of the proposed Arrow LNG Plant dictates that a considerably larger diameter pipeline than that proposed for CQP is required for the transmission of CSG from the Bowen Basin; and
- Future coal mining expansion south east of Moranbah requires that at least the first 150 km of the CQP will need to be re-routed to ensure that valuable coal deposits are not sterilised.

The extent of Arrow's Petroleum Leases (PLs) and Authority to Prospect areas north of Moranbah indicate that a more refined pipeline route should be examined to bring gas from these areas to the Arrow LNG Plant on Curtis Island.

The proposed pipeline route will follow the former, and now relinquished, Papua New Guinea (PNG) pipeline route from the Broadsound Range to Rockhampton. From Rockhampton to Gladstone, the SGIC SDA is being considered for the proposed pipeline route which terminates at a proposed gas hub near Mount Larcom, approximately 22 km southwest of Gladstone. From the gas gathering station the pipeline will connect to the ASP for delivery to the proposed Arrow LNG Plant.

2.2.2. NO PROJECT OPTION

The consequences of not proceeding with the project would mean the benefits outlined in **Section 2.1** would not be realised. This would be to the detriment of the local, regional, state and national economies. Increased competition in the gas supply market would potentially be compromised, potential increase in export markets would likely be delayed or not achieved and the direct economic benefit from construction expenditure and the longer term benefits of the pipeline operation would not be realised.

2.2.3. ALTERNATIVE PIPELINE ROUTE OPTIONS

Arrow explored a number of alternative pipeline route options for the supply of CSG from the Bowen Basin to the Arrow LNG Plant on Curtis Island. One of Arrow's objectives for the project, is to cost effectively deliver CSG from Bowen Basin resources to the Arrow LNG Plant at Curtis Island for export to customers.

To deliver on this objective, the proposed pipeline route needs to be:

- Located in a pipeline corridor that allows cost effective construction while minimising impacts to the environment, landholders, local communities and mining interests;
- Optimally configured to efficiently accommodate current capacity requirements while allowing for cost effective expansion to meet future capacity requirements; and
- Designed and constructed in compliance with relevant standards while achieving capital and operating cost efficiencies through innovation in design and construction.

The pipeline route options were based initially on a desktop assessment of topographical and ecological mapping and further investigated by Coffey Environments Australia Pty Ltd. which has been documented in the *Proposed Pipeline Alignment Travelogue* (Coffey, 2010) (**Appendix A4.7**, **Volume 3**). Each alternative pipeline route commenced in the Bowen Basin, approximately 90 km north of Moranbah and consisted of a number of headers and lateral pipeline options. Following this desktop review, field surveys concentrated on two alternative pipeline route options as illustrated in **Figure 2-1**.

The proposed pipeline route takes a more direct route to Gladstone, whereas the southern alternative pipeline route travels from near Middlemount adjacent to the not yet constructed CQP route to the Mackenzie River where it deviates south to the Calliope Range before joining the Callide Infrastructure Corridor where it would join the proposed ASP to Gladstone.

The alternative pipeline route is 60 km longer, transects cropping land adjacent to the Mackenzie River and Dulu and faces a number of challenging construction limitations in traversing the difficult terrain of the Calliope Range. The alternative pipeline route has since been discounted due to higher construction costs and to avoid impacting endangered cycad populations naturally occurring in the Calliope Range.

2.2.4. SUMMARY

The primary objective of transporting CSG from the Bowen Basin to Gladstone economically and at volumes sufficient to feed the Arrow LNG Plant requires a large diameter dedicated pipeline or a shared pipeline. The proposed pipeline route is located centrally to Arrow Energy's CSG reserves in the Bowen Basin.

Although other pipelines are proposed within the project area e.g. CQP, no suitable pipeline currently exists or is likely to be constructed ahead of the project to bring gas from the Bowen Basin to Gladstone to ensure reliability of supply to the proposed Arrow LNG Plant on Curtis Island.

ARROW BOWEN PIPELINE PRELIMINARY ROUTE (REV D)

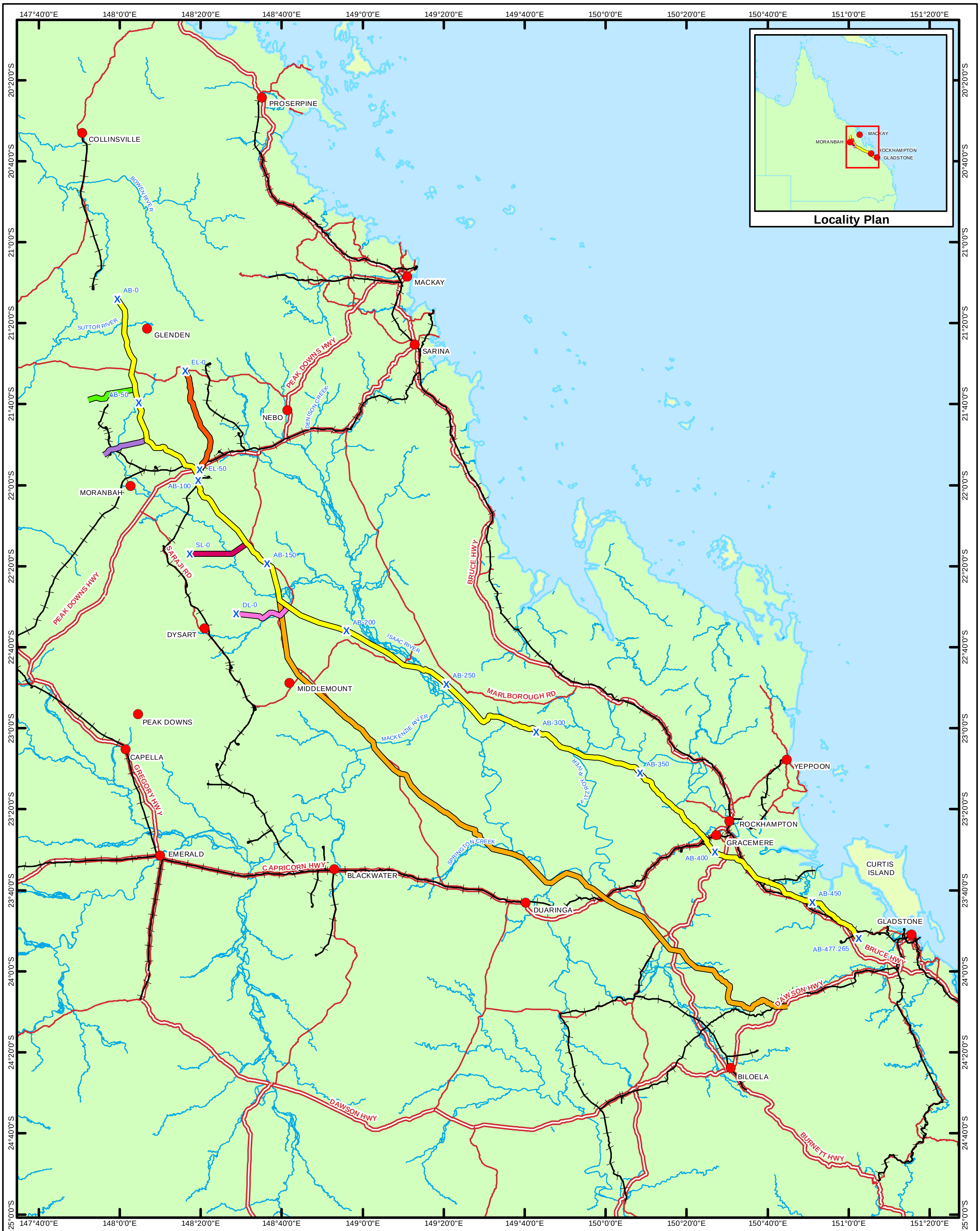


Figure 2 - 1: Alternative route options for the project

Legend

- Localities
- Kilometre Points
- AB Mainline Rev D
- Dysart Lateral Rev D
- Elphinstone Lateral Rev D
- Saraji Lateral Rev D
- Alternative Mainline Rev C
- Goonyella North Lateral RevC
- Goonyella South Lateral RevC
- Railways
- Highways
- Major Roads
- Major Watercourses

Data Sources:
StreetPro: Localities, Roads, Railways
DERM: Major Watercourses
Data Supplied by Arrow Energy:
ABP Mainline RevD,
ABP Lateral RevD
ABP Alternative RevC
Kilometre Points

N

arrow energy
go further

0 25 50
Kilometres

Scale: 1:2,250,000 @ A4
Coordinate System: GCS GDA 1994

Document: I:\ENVR\Projects\EN02962\Spatial\ArcGIS\V1\Figure_2_1_Alternative_route_options_A4.mxd Date: 5/12/2011

NOT FOR CONSTRUCTION

3. DESCRIPTION OF THE PROJECT

The project will involve the construction of approximately 580 km of high pressure gas pipelines in Central Queensland comprising a main pipeline (the AB mainline), three lateral pipelines (EL, SL and DL) and associated infrastructure. The pipeline will be laid in a trench with a minimum depth of cover of 750 mm. At watercourse crossings, the minimum depth of cover will be increased to at least 1,200 mm.

A 30 m wide ROW will be established for construction and converted into a 30 m wide operational easement for subsequent pipeline operation and maintenance.

The project will have a minimum technical design life of 40 years, however, with ongoing integrity management the operational life is expected to be in excess of this figure.

The proposed pipeline will be typical of a modern, large diameter gas transmission pipeline and will be designed, constructed and operated in accordance with the Australian Standard 2885 series, particularly:

- AS 2885.0 Part 0 – Pipelines, Gas and liquid petroleum, General requirements;
- AS 2885.1 Part 1 – Design and Construction;
- AS 2885.2 Part 2 – Welding;
- AS 2885.3 Part 3 – Operations and Maintenance; and
- AS 2885.5 Part 5 – Field Pressure Testing.

Final design parameters of the project are yet to be determined, but will most likely include:

- A buried, high pressure, steel, natural gas pipeline, with a nominal diameter of up to 42 inch (DN1050) for the AB mainline and up to 20 inch (DN500) for the lateral pipelines including some 16 inch (DN400) buried steel pipeline.
- A connection to a proposed gas hub near the Bruce Highway, approximately 22 km southwest of Gladstone;
- Above ground facilities at intervals along the proposed pipeline route including mainline valves, scraper stations, cathodic protection systems and marker signs; and
- Temporary workers‘ accommodation camps.

All materials and workmanship shall be in accordance with the applicable codes and standards referenced in AS 2885. In addition, the pipeline design shall also comply with the specific requirements of the P&G Act, the PPL and the associated EA.

The following health and safety studies will also be conducted by Arrow for the project design process:

- A *Pipeline Safety Management Study* series in accordance with AS 2885 (part 1 is included in **Appendix A4.6**, **Volume 3**). This includes developing a line pipe fracture control plan; and
- A *Hazard and Operability Study* for any above ground facilities.

3.1. LOCATION

3.1.1. REGIONAL CONTEXT

The project will commence approximately 90 km north of Moranbah in Central Queensland and terminate at a proposed GGH approximately 22 km southwest of Gladstone where it will join the ASP for further transmission to the proposed Arrow LNG Plant on Curtis Island.

The proposed pipeline route traverses four local government areas (LGAs) (**Figure 1-1**) including:

- Whitsunday Regional Council;
- Isaac Regional Council;
- Rockhampton Regional Council; and
- Gladstone Regional Council.

The proposed pipeline route will commence in the southern part of the Whitsunday Regional Council, traverse the Isaac and Rockhampton Regional Councils in a southerly direction and terminate in the Gladstone Regional Council. The proposed pipeline route also traverses land included within two SDAs, being the SGIC SDA and the GSDA (refer to **Figure 3-1** and **Figure 3-2**).

Main centres and smaller townships located within the project area[4] include:

- Glenden;
- Nebo;
- Moranbah;
- Dysart;
- Middlemount;
- Marlborough;
- Rockhampton;
- Gracemere;
- Bouldercombe;
- Duaringa;
- Bajool;
- Raglan;
- Gladstone;
- Mount Larcom; and
- Calliope.

The location of each main centre in relation to the proposed pipeline route is shown on **Figure 1-1** and **Map 1**, **Volume 2**.

[4] The area that may be impacted on directly or indirectly by the project

ARROW BOWEN PIPELINE PRELIMINARY ROUTE (REV D)

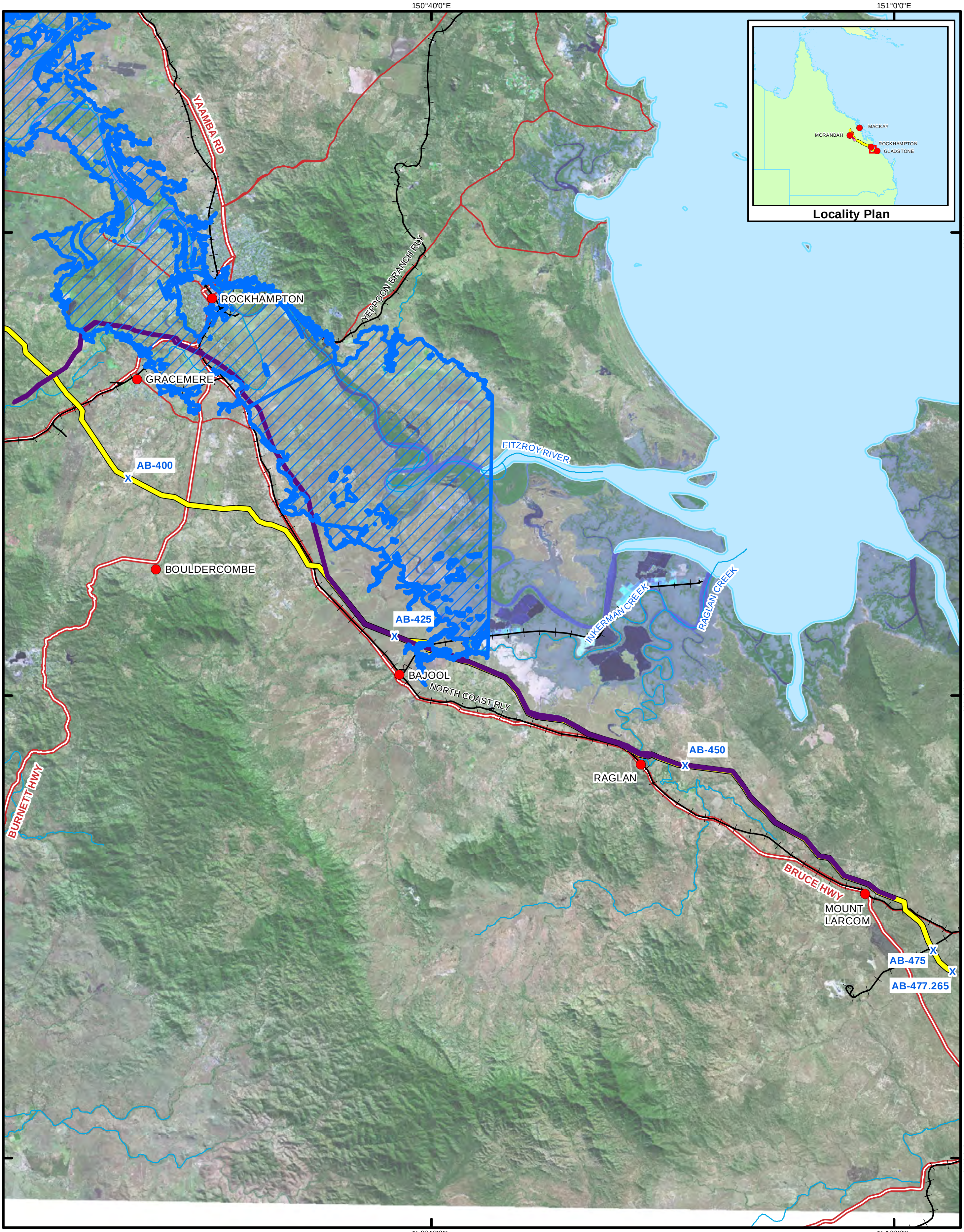


Figure 3 - 1: Stanwell-Gladstone Infrastructure Corridor in relation to the proposed pipeline route

Legend

- Localities
- Kilometre Points
- AB Mainline Rev D
- Railways
- Highways
- Major Roads
- Major Watercourses
- Floodlines
- Stanwell-Gladstone Infrastructure Corridor

Data Sources:
SPOT Imagery
StreetPro: Localities, Roads, Railways
DERM: Major Watercourses, Floodlines
Data Supplied by Arrow Energy:
ABP Mainline RevD, Kilometre Points
Department of Employment, Economic Development and Innovation
Stanwell-Gladstone Infrastructure Corridor

N

0 5 10
Kilometres

Scale: 1:400,000 @ A4
Coordinate System: GCS GDA 1994

arrow energy
go further

Document: I:\ENVR\Projects\EN02962\Spatial\ArcGIS\V1\Figure_3_1_Stanwell_Gladstone_Infrastructure_Corridor_in_relation_to_the_proposed_pipeline_A4.mxd Date: 5/12/2011

NOT FOR CONSTRUCTION

ARROW BOWEN PIPELINE PRELIMINARY ROUTE (REV D)

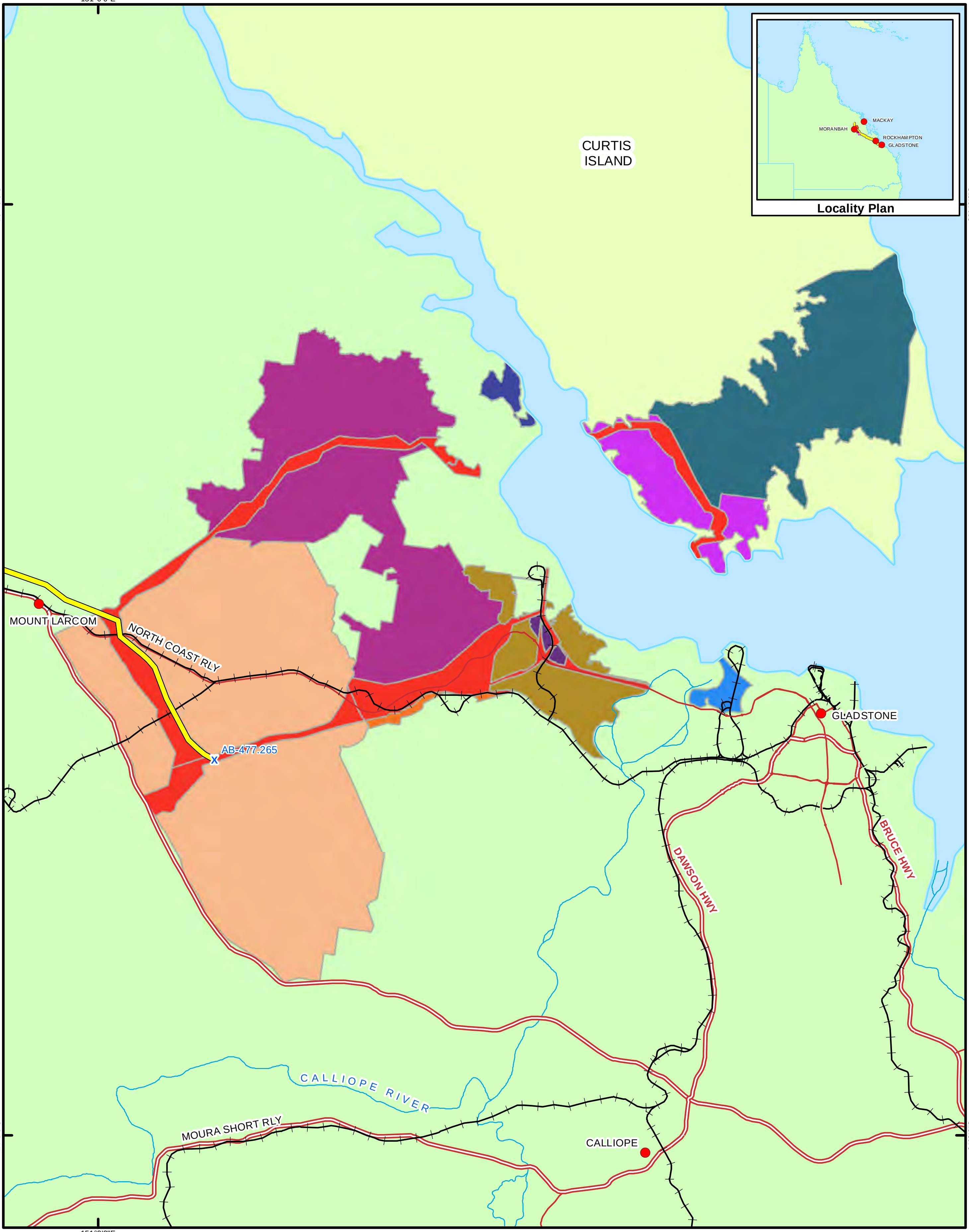


Figure 3 - 2: Gladstone State Development Area in relation to the proposed pipeline route

Legend

- Localities
- Kilometre Points
- AB Mainline Rev D
- Railways
- Highways
- Major Roads
- Major Watercourses

Gladstone State Development Area

- Corridor Buffer Area Precinct
- Curtis Island Industry Precinct
- Environmental Management Precinct (Curtis Island)
- Environmental Management Precinct (Kangaroo Island)
- Materials Transportation and Services Corridor
- Stuart Oil Shale Reserve Preservation Area
- Targinnie Precinct
- Yarwun Precinct
- Aldoga Precinct
- Clinton Precinct

Data Sources:
StreetPro: Localities, Roads, Railways
DERM: Major Watercourses,
Data Supplied by Arrow Energy:
ABP Mainline RevD, ABP Lateral RevD
Kilometre Points
Department of Employment, Economic Development and Innovation: Gladstone State Development Area

N

0 1 2 3 4 5
Kilometres

Scale: 1:200,000 @ A4
Coordinate System: GCS GDA 1994

Document: I:\ENVR\Projects\EN02962\Spatial\ArcGIS\V1\Figure_3_2_Gladstone State Development Area_A4.mxd Date: 5/12/2011

NOT FOR CONSTRUCTION

3.1.2. LOCAL CONTEXT

The local context of the proposed pipeline route described in this section is based on information provided within the *Arrow Bowen Pipeline – Proposed Pipeline Alignment Travelogue* prepared by Coffey, 2011 (**Appendix A4.7**, **Volume 3**). Key infrastructure mentioned in this section is illustrated in **Map series 8**, **Volume 2**.

Real property descriptions (RPDs) of the land crossed by the proposed pipeline route are provided in **Appendix A4.8**, **Volume 3** and land tenure and tenement information is detailed in **Section 3.3.1**.

The local context is described in accordance with kilometre points (KP) as follows:

- For the Arrow Bowen (AB) mainline – AB is the prefix for kilometre point; AB0 indicating the most northern point and AB477 indicating the most southern point;
- For the Elphinstone Lateral (EL) – EL is the prefix for kilometre point; EL0 indicating the most northern point and EL52 indicating the most southern point where this lateral feeds into the AB mainline;
- For the Saraji Lateral (SL) – SL is the prefix for kilometre point; SL0 indicating the most western point and SL25.8 indicating the most eastern point where this lateral feeds into the AB mainline; and
- For the Dysart Lateral (DL) – DL is the prefix for kilometre point; DL0 indicating the most western point and DL25.7 indicating the most eastern point where this lateral feeds into the AB mainline.

Arrow Bowen mainline

The mainline is a 477 km high pressure gas pipeline that starts near Eastern Creek colliery north of Moranbah and connects to the ASP near Larcom Creek, east of the Bruce Highway and west of Gladstone.

The mainline commences immediately south of Mining Lease (ML) 10352 (Xstrata Coal Qld) and is located to the eastern part of Arrow Energy's exploration permits EPP742 and 364. The mainline heads in a southeast direction between ML 10352 and ML 10362 (Xstrata Coal Qld), crossing the Newlands Access Road and Suttor Creek at AB12.3 (**Plate 3-1**). The AB mainline continues to the southeast crossing a tributary of Eaglefield Creek at AB28.3 before crossing the Suttor Developmental Road at AB34.75 (**Plate 3-2**).

Plate 3-1: Newlands Access Road

Plate 3-2: Suttor Developmental Road

The AB mainline continues southward through the centre of Arrow Energy's tenements between ML 70456 (New Lenton Coal Pty Ltd) to the east and ML 70443 (BHP Mitsui Coal Pty Ltd) to the west, crossing Red Hill Road at AB36.8 and a tributary of Skull Creek at AB44.1. South of the highway, the mainline traverses predominantly cleared terrain to the Isaac River at AB50.2 and Red Hill Road adjacent to the river. The mainline turns to the southwest, crossing Hurricane Creek at AB53.9 and 12 Mile Creek at AB59.1. The mainline continues south between ML 70252 (Peabody (Burton Coal) Pty Ltd) to the east and ML 70421 (BHP Coal Pty Ltd) to the west, following gentle ridges and spurs to the south side of Teviot Brook which is crossed at AB68.25. Turning to the southeast, the AB mainline crosses the double circuit Nebo-Moranbah 132 kV overhead transmission line at AB70.05.

The mainline turns to the east crossing Peabody's haul road at AB73.5 (**Plate 3-3**) and runs between ML 70257 (Peabody (Burton Coal) Pty Ltd) immediately to the north and ML 70338 (Vale Australia CQ Pty Ltd) (**Plate 3-4**) immediately to the south. At AB77.65, the mainline turns southeast running parallel to a tributary of Smoky Creek (**Plate 3-5**) before crossing that tributary at AB78.65. The 132 kV transmission line is again crossed at AB77.9. The mainline continues southeast crossing the Goonyella Branch Line at AB90.1 approximately 100 m west of railway control infrastructure before again turning east to run parallel with a water supply pipeline immediately north of MDL 354 (Vale Australia CQ Pty Ltd). The AB mainline then crosses the Peak Downs Highway at AB95 (**Plate 3-6**).

Plate 3-3: Peabody Haul Road crossing

Plate 3-4: Proposed pipeline route lies between ridge to north and the Vale ML to the bottom of the photo

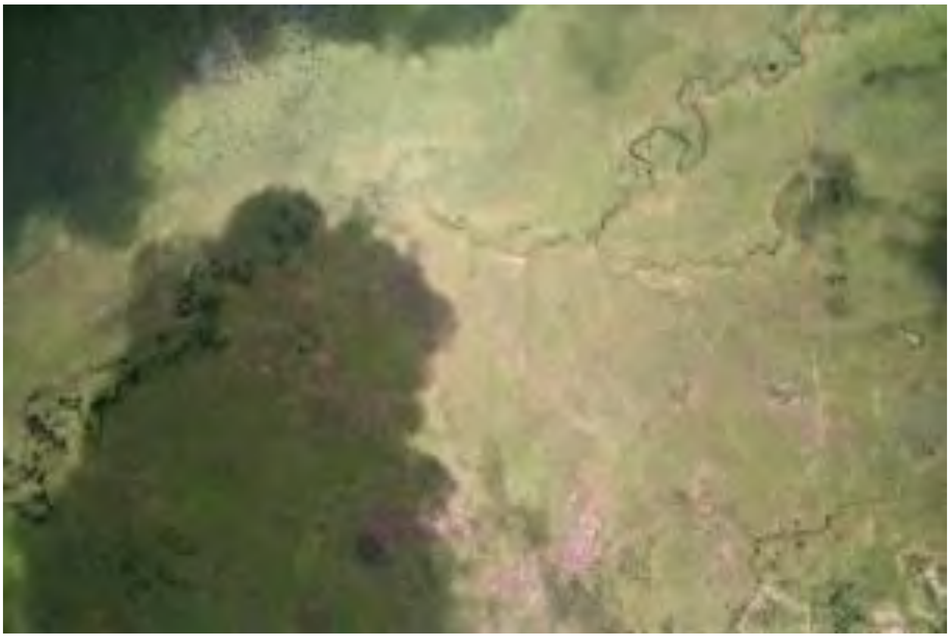


Plate 3-5: Smoky Creek

Plate 3-6: Peak Downs Highway

The AB mainline crosses the Peak Downs Highway approximately 200 m east of a rehabilitated dragline route and then crosses an easement containing two single circuit 132 kV transmission lines. The AB mainline continues south, parallel with Daunia Road crossing another double circuit 132 kV transmission line at AB99.35. The mainline then crosses the Norwich Park Branch Line at AB101 (**Plate 3-7**) and continues west of Annandale Road immediately adjacent to ML 70290 (Coppabella Coal Pty Ltd). The mainline crosses North Creek at AB105.8 avoiding stockyards which are located on the east side of North Creek, 120 m east of AB105. From there, the AB mainline crosses North Creek at AB109.3 and Annandale Road several times at AB109.4, AB112 and AB119.05.

Plate 3-7: View southeast to Norwich Park Branch Line crossing

From here, the AB mainline is heavily constrained by existing mining leases and continues southeast, traversing the slopes of Mt Coxendean and passing several dams in the area at AB125.3 and another large dam at AB132. The Iffley Connection Road is crossed at AB136.9, before the AB mainline reaches the bend at AB137.15. At approximately AB142, the mainline runs adjacent to the Fitzroy Developmental Road for over 10 km before turning south. The mainline continues in a southerly direction crossing the Isaac River at AB164.7, an anabranch of that river at AB165.5 and Stephens Creek at AB171.7. The Fitzroy Developmental Road is crossed at AB173 (**Plate 3-8**).

Plate 3-8: Fitzroy Developmental Road

The AB mainline avoids several dams between AB180.5 and AB187.85 and then crosses May Downs–Carfax Road at AB195.4 and continues southeast avoiding numerous other dams along this section. The AB mainline continues generally parallel to Rolf Creek which is then crossed, including anabranches, at approximately AB212.8. Continuing southeast, the AB mainline traverses cleared land to the bend at AB228.8, crossing May Downs Road at AB228.1 (**Plate 3-9**).

Plate 3-9: May Downs Road

May Downs Road, the Ungle waterhole, the Mackenzie River and the Broadsound Range constrain the AB mainline from AB228.1 to AB273.4. The AB mainline passes 1.5 km south of May Downs Waterhole and crosses the Isaac River at AB234.45 before turning southeast and traversing cleared land between the Isaac River and Ungle Waterhole (**Plate 3-10**) located 350 m east of the mainline. The AB mainline crosses the main anabranch of the Isaac River at AB238 and then Stockyard Creek further south at AB239.55. Several other creeks are then crossed including Bora Creek at AB245.1, Clive Creek at AB249.05 and Plumtree Creek at AB251 as the mainline continues south. The Broadsound–Lilyvale 275 kV transmission is crossed at AB253.4 followed by the Manly Access Road at AB254.6 (**Plate 3-11**). The AB mainline maintains this direction crossing Coppermine Creek at AB259.6, unnamed creeks at AB261.4 and AB262.4, Tartrus Road at AB263.6 and Spring Creek at AB271.4. At AB272.65, the AB mainline turns east southeast to run generally parallel to the existing fence across Pluto Creek at AB273.4 (**Plate 3-12**).

Plate 3-10: View northeast to Ungle Waterhole

Plate 3-11: Manly Access Road

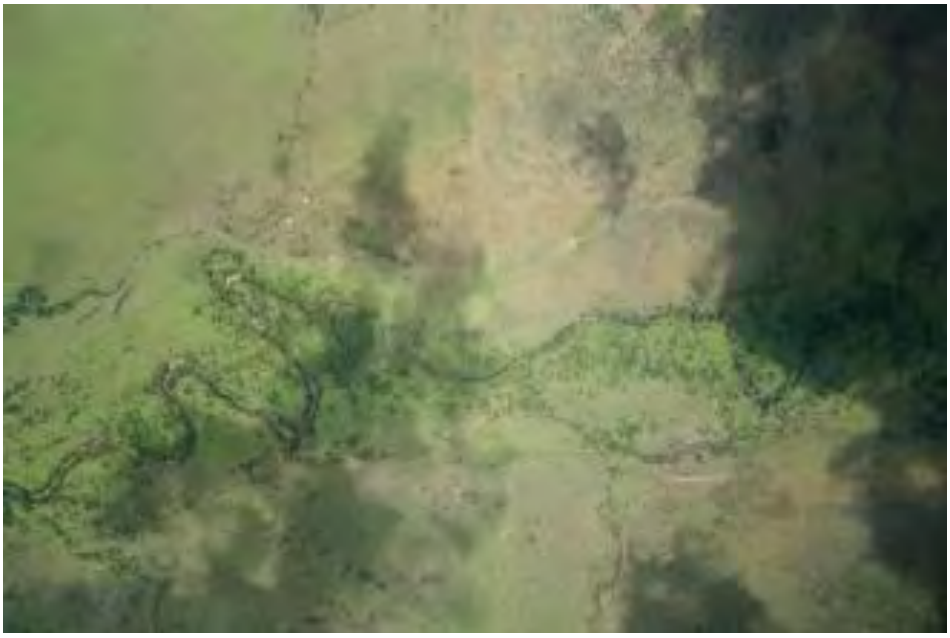


Plate 3-12: Pluto Creek

East of the Broadsound Range, the AB mainline is constrained in the south by the Boomer Range (parts of which are included in the Goodedulla National Park and Devlin State Forest) and in the north by the range extending west and south of Mt Redcliffe near Marlborough, particularly the Eugene State Forest. Once crossing Pluto Creek, the AB mainline turns northeast passing stockyards at AB276.3 and recrossing Pluto Creek at AB278.9 and AB279.65. The AB mainline turns east around the northern end of the Boomer Range avoiding several dams in this section and crossing Apis Creek at AB284.2 adjacent to

Duaringa-Apis Creek Road. Continuing east southeast, the AB mainline crosses Bluewater Creek at AB292.15, a single wire earth return powerline at AB291.3 and Clifton Road at AB291.8. A bend in the AB mainline allows it to follow an access track through to crossing a tributary of Sweet Water Creek downstream of the existing vehicle (access track) crossing. An easement containing three high voltage transmission lines is crossed at AB303.45 before the alignment follows Devlin Creek downstream avoiding more dams. Ten Mile Creek is crossed at AB308.85 before the turning southsoutheast to converge on Morbank Road.

The AB mainline runs parallel to Morbank Road to avoid a tributary of Ten Mile Creek and numerous dams before crossing the road, avoiding a dam at AB313.35. Turning east at this point the AB mainline generally follows the ridgeline north of Ten Mile Creek which it crosses at AB314.7, followed by Glenroy–Marlborough Road at AB316.6. Heading southeast, the AB mainline crosses the Fitzroy River at AB319.6 (**Plate 3-13**). The AB mainline again turns east following Redbank Road and crossing the proposed Marlborough Nickel slurry pipeline at AB329.2. Turning eastsoutheast, the AB mainline crosses a tributary of Eight Mile Creek at AB336.25 and Fairview Road at AB337. From AB345, the AB mainline parallels with the Marlborough Nickel slurry pipeline crossing several tributaries of Six Mile Creek and avoiding several dams.

Plate 3-13: View east along the Fitzroy River following heavy rainfall; AB mainline crossing in middle of photo

Slurry pipeline route

The AB mainline continues southeast parallel to the Marlborough Nickel slurry pipeline and crosses Glenroy Road at AB351, Station Creek at AB352.55, several tributaries of Station Creek, a single circuit 275 kV transmission line at AB354.7, Craignaught Road at AB355.8, Storer Gully at AB356.75 and Mornish Road at AB358. At this point the AB mainline is also parallel to a 275 kV transmission line. The AB mainline turns southsoutheast to cross Faraday Road at AB364.5, an unnamed watercourse at AB364.75, Dalma–Ridgelands Road at AB365.4, Limestone Creek at AB371.25, Stanwell–Waroula Road at AB372 (**Plate 3-14**), Deep Creek at AB373.35 and Deep Creek Road at AB375.15. The AB mainline continues following the general route of the Marlborough Nickel slurry pipeline southeast crossing several creeks including Black Gin Creek at AB377.6, Lion Creek at AB382.7 and a tributary of Neerkol Creek at AB387.3. At this point, a water supply pipeline is crossed immediately north of the creek. The AB mainline continues parallel to the Marlborough Nickel slurry pipeline in predominantly cleared terrain until intersecting the SGIC SDA at AB389.85.

Plate 3-14: Stanwell-Waroula Road

After crossing the SGIC SDA, the AB mainline follows the Marlborough Nickel slurry pipeline with Hopper Road crossed at AB390.65, a lagoon at AB390.45 (at the toe of the small hill), Neerkol Creek at AB391.3 and a crossing of a 275 kV transmission line at AB390.7 on the south side of Hopper Road. At AB391.75, the AB mainline diverges from the Marlborough Nickel slurry pipeline crossing it at AB391.8 as it continues southeast crossing the Bouldercombe–Broadsound 275 kV transmission line and the Capricorn Highway at AB393 and adjacent to Central Railway at AB393.05 (**Plate 3-15**).

Two houses are located within 100 m of the ROW at AB395 (approximately 80 m) and AB440 (approximately 98 m).

The AB mainline continues parallel to the Marlborough Nickel slurry pipeline crossing three high voltage (275 kV) transmission lines. The AB mainline then crosses several creeks between this point and the Burnett Highway crossing the Burnett Highway at AB404.9. Turning eastnortheast, the AB mainline crosses the Queensland Gas Pipeline at AB409.5

before following it south to cross Mogilno Road at AB410.7 and converging with the Bruce Highway, which it crosses along with the North Coast Line at AB416.45. After crossing the highway, the mainline enters the SGIC SDA at AB417.85.

Plate 3-15: View southeast to crossing of Capricorn Highway and Central Railway

Stanwell-Gladstone Infrastructure Corridor State Development Area

The AB mainline adopts the westernmost slot in the SGIC SDA which is nominally 100 m wide. This section of the AB mainline crosses numerous creeks, unnamed tributaries and lagoons associated with Eight Mile Creek to AB430.15. The AB mainline then travels along the high ground between the lagoons and anabranches extending outside the SGIC SDA before continuing within the SGIC SDA. The AB mainline crosses Bajool–Port Alma Road at AB431.4 (**Plate 3-16**) avoiding numerous dams in the area and a quarry near AB437.1. Continuing in the SGIC SDA, the AB mainline again crosses numerous creeks between AB438.8 and AB442.4 while avoiding a residential dwelling, sheds, dams and a stockyard at AB443.4. Raglan Creek is crossed at AB446.5 (**Plate 3-17**) and Reedy Creek Road is crossed at AB455. Arrow is investigating a small realignment outside the SGIC in the vicinity of Inkerman Creek (AB425 to AB431) in order to obtain a more appropriate crossing of the CQ Salt railway and to avoid permanent/ semi-permanent billabongs adjacent to Inkerman Creek. This is illustrated in Map series 8, Volume 2, Page 32. The current alignment of the SGIC SDA in this area does not allow a horizontal directional drill or thrust bore under the CQ Salt rail line at right angles to the rail line nor allow a suitable area for stringing of the pipeline for construction using these methods.

The proposed Balaclava Island Coal Terminal Railway crosses the ABP mainline at AB445.5. The AB mainline traverses a small dam at AB454.95 (immediately west of Reedy Creek

Road) which may need to be relocated. The AB mainline continues parallel to Raglan Station Road before turning southeast crossing Darts Creek Road at AB462, the single circuit Gladstone–Bouldercombe 275 kV transmission line at AB462.8 and the proposed CQP (PPL121) at AB462.9 where it is located adjacent to the transmission line easement. Further investigation of this crossing is required to avoid multiple crossings and to provide adequate separation of the proposed pipelines.

The SGIC SDA ends at AB469.6 where the AB mainline enters the GSDA and continues southeast, crossing the proposed Northern Infrastructure Corridor (NIC) at AB470.05 before crossing the North Coast Line Railway and Gladstone–Mount Larcom Road at AB471 and AB471.05 respectively (**Plate 3-18**). At AB476, the AB mainline turns southeast to cross Larcom Creek at AB476.2 to its intersection with the ASP at AB477.25. The Wallumbilla-Gladstone Pipeline is crossed at AB477.2.

Plate 3-16: Bajool-Port Alma Road

Plate 3-17: Raglan Creek

Plate 3-18: View east to crossing of Gladstone-Mount Larcom Road and North Coast Railway

Elphinstone Lateral

The 52 km long Elphinstone Lateral starts in the headwaters of Walker Creek near Lake Elphinstone and traverses that creek valley, passing west of Coppabella to the AB mainline in the vicinity of Annandale Station.

The proposed Elphinstone Lateral commences approximately 2 km east of Lake Elphinstone, approximately 800 m south of the Suttor Developmental Road, and approximately 1.5 km west of ML 4750 at the watershed of Walker Creek. Commencing at EL1 the lateral heads south southeast in high ground areas before crossing Walter Creek at EL4.6 and EL11.5 and passing adjacent to Carborough Range. At EL13, the lateral crosses the double circuit Nebo–Moranbah 132 kV transmission line. The Elphinstone Lateral continues south to southeast in gently undulating terrain avoiding a dam east of EL26.1 (**Plate 3-19**), crossing Carborough Creek at EL28.4 and passing the edge of a freshwater wetland between EL31.4 and EL31.8. South of EL38.9, the lateral makes a series of bends to ensure perpendicular crossings of the numerous watercourses that drain the eastern face of the Carborough Range. At EL46.65, the lateral turns south to cross a 132 kV transmission line at EL46.75, the Goonyella Branch Railway at EL47 and the Peak Downs Highway at EL47.7. South of the Highway the Elphinstone Lateral turns west southwest and continues until joining the AB mainline at AB95.85.

Plate 3-19: View east to dam avoided by the Elphinstone Lateral

Saraji Lateral

The 25.8 km longSaraji Lateral commences approximately 5 km east of the Peak Downs colliery in the vicinity of the proposed CQP (PPL 121) and connects to the AB mainline at AB137.1.

The proposed Saraji Lateral commences in the vicinity of the proposed CQP (**Plate 3-20**) and heads east toward Ripstone Creek. The lateral crosses Ripstone Creek, approximately 650 m north of SL5.6 and avoids the lagoons, dams and flood runner. Turning east to northeast from the bend south of EL13.5, the alignment crosses the Isaac River. Once crossing the Isaac River the lateral heads northeast until joining the AB mainline at AB137.1.

Dysart Lateral

The Dysart Lateral commences approximately 13 km southeast of Norwich Park collieries and 14 km northeast of Dysart adjacent to Golden Mile Road which it follows to the Fitzroy Developmental Road before following that road to the AB mainline and connecting at AB172.9.

The Dysart Lateral follows the northern side of Golden Mile Road east towards the Fitzroy Developmental Road avoiding several dams (**Plate 3-21**) and a borrow pit at DL16.2 adjacent to the lateral. Golden Mile road and Stephens Creek are crossed at DL17.1. Continuing parallel to the Road, the Dysart Lateral crosses Blackburn Creek at DL8.3 an anabranch of Blackburn Creek at DL19.5 before turning northeast through a splayed bend to follow the Fitzroy Developmental Road to the AB mainline which it joins at AB172.9.

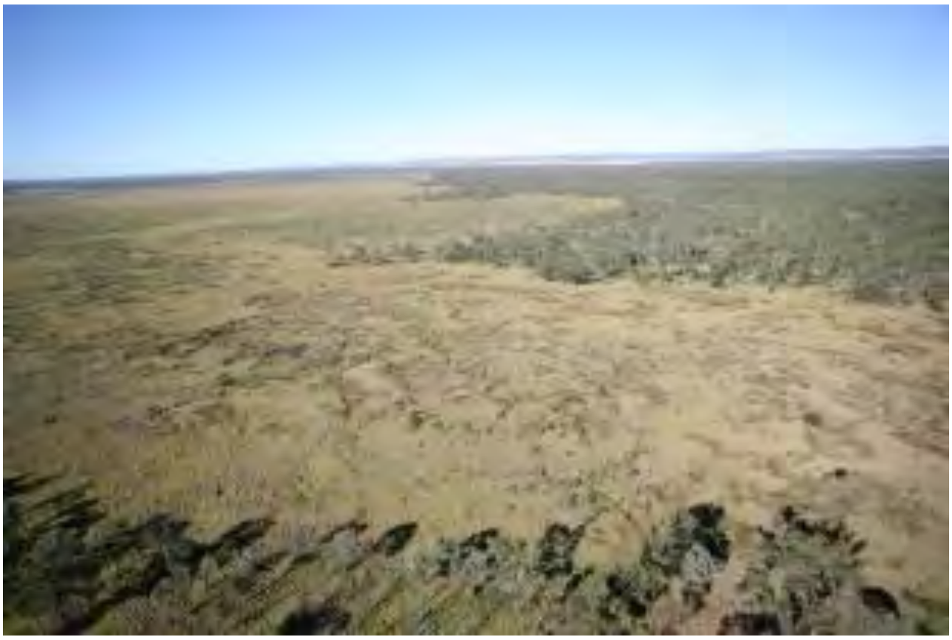


Plate 3-20: View southwest to starting point of Saraji Lateral; note Peak Downs colliery in background

Plate 3-21: View south to dams on south side of Golden Mile Road

3.1.3. CO-LOCATION

A number of opportunities for possible co-location of the proposed pipeline route with other planned pipeline corridors have been identified in the planning of the project. They include:

- CQP: this pipeline route utilises one of only two feasible passages through the series of ranges that parallel the Queensland coast;
- Gladstone Nickel Pipeline: Gladstone Pacific Nickel Ltd (formerly Marlborough Nickel Pty Ltd) has lodged an application for a mining lease (ML 80134) for a proposed slurry pipeline from the proposed mine site along Marlborough Creek near Develin to near Midgee, south of Rockhampton;
- PNG Gas Project: the proposal to construct this pipeline from Cape York to Gladstone was put on hold by the proponents, AGL Petronas Consortium, in September 2006. The route for this pipeline, as described in the PNG Gas Project EIS, traverses the western side of the Broadsound Range before following, in part, the proposed Gladstone Nickel Pipeline route, after which it deviates to the north and east to run to Rockhampton and on to Gladstone;
- SGIC SDA: declared by the Queensland Government for pipeline infrastructure between Stanwell and Mount Larcom, following a proposal by the Gladstone Area Water Board (GAWB) for the Gladstone – Fitzroy Water Pipeline. This generally 100 m wide reserve is the Queensland Government's preferred corridor for pipeline routes south of Stanwell.

None of the four proposed pipelines have been built to date. However, the EISs have assisted Arrow in selecting a suitable route for the proposed pipeline route from the Broadsound Range to Gladstone to maximise the opportunity for future co-location and to minimise potential environmental constraints.

Maximising co-location opportunities – Broadsound Range to Gladstone

The key constraint for the proposed pipeline route is traversing the ranges running parallel to, and inland of, the Queensland coast. The two options considered for the proposed pipeline route were the valley between the Native Cat and Razorback ranges at Stanwell (the route adopted for the CQP) and Apis and Pluto creeks between the Broadsound and Boomer ranges. The CQP route adjacent to Stanwell is constrained by power station infrastructure and small landholdings to the east of the power station. This route is not the most direct route. In contrast, routes via Pluto Creek are shorter and less congested and are favoured over the CQP route.

Adopting Pluto Creek as the preferred crossing of the Broadsound and Boomer ranges results in pipeline route selection being divided into two sections, the section south of the Broadsound Range and the section north of that range.

The pipeline corridor investigated for the PNG Queensland Gas Pipeline Project offers the most feasible pipeline route options for the proposed pipeline route from the Broadsound Range to south of the Fitzroy River where it intersects the proposed Gladstone Nickel Pipeline route. The route follows the general alignment of the Gladstone Nickel Pipeline route to south of Midgee.

The SGIC SDA and PNG Queensland Gas Project pipeline corridor traverse the extensive lagoon systems of the Fitzroy River floodplain in the vicinity of Rockhampton. Numerous watercourse crossings are required to negotiate these water bodies, some of which are permanent waterholes. Heavy rains and flooding immediately prior to the helicopter inspection showed extensive inundation of land traversed by these pipeline corridors. In contrast, the Gladstone Nickel Pipeline route (slurry pipeline) was observed to be largely unaffected by flooding. The extent of flood inundation of the SGIC SDA in this area is shown in **Figure 3-1**. Accordingly the adoption of the proposed slurry pipeline route south of Rockhampton offers the greatest protection from flood immunity to the proposed pipeline.

Arrow is aware that the Rockhampton Regional Council is planning for a future industrial estate in the Gracemere area and discussions are being held between Arrow and Rockhampton Regional Council to ensure that development planning for the future industrial estate and the pipeline can be suitably accommodated.

South of Midgee the proposed pipeline route runs in and adjacent to the western side of the SGIC SDA to Mount Larcom. South of Mount Larcom the proposed pipeline route generally follows the CQP route to its junction with the proposed ASP. The CQP route is located adjacent to and west of the proposed Northern Infrastructure Corridor. The SGIC SDA is located in predominantly cleared land to the east of the Bruce Highway. It crosses numerous watercourses, some subject to tidal flows. Extensive lagoon systems are traversed in the vicinity of Bajool.

In order to ensure safe constructability and operation, neither the required ROW nor easement width are reduced as a result of co-location.

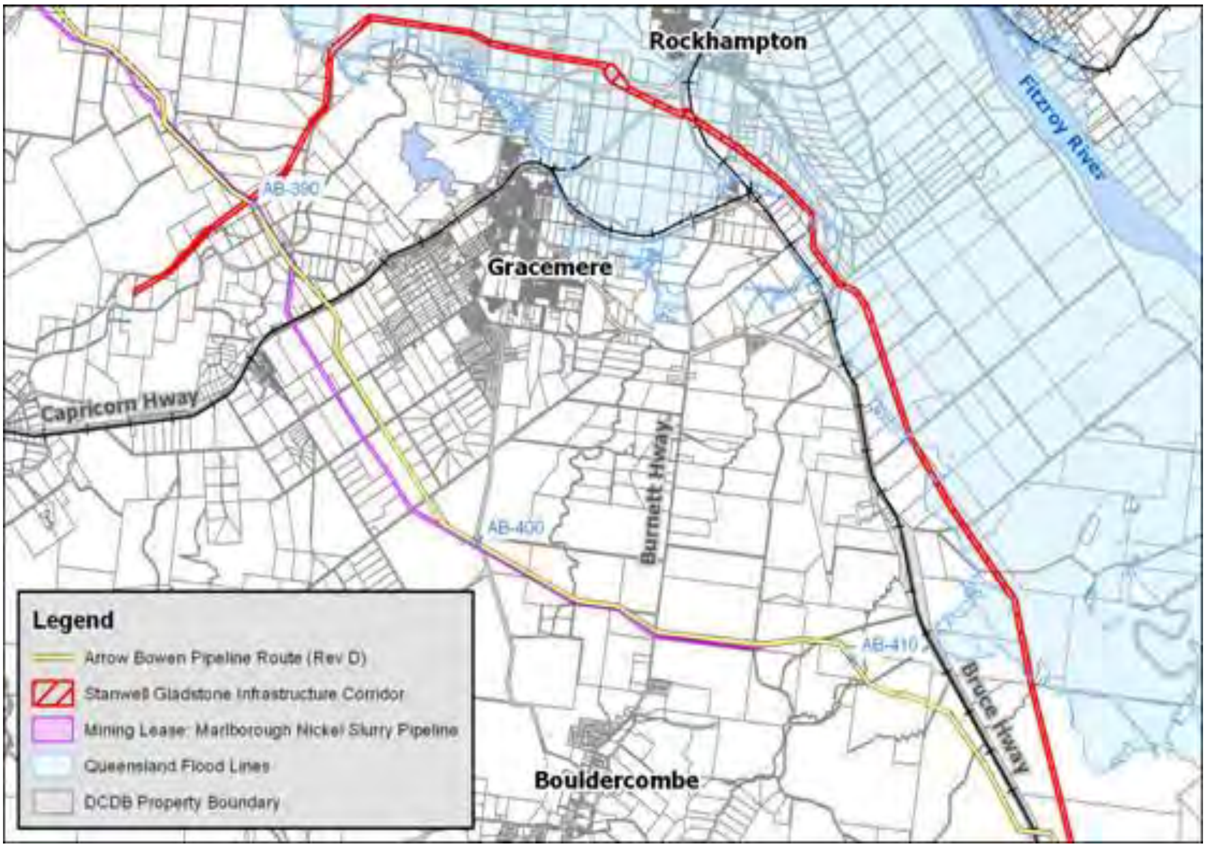


Figure 3-3: Flood inundation area in the norther portion of the SGIC

3.2. CONSTRUCTION

The construction methodology for a gas transmission pipeline is similar in many ways to that of other linear infrastructure such as a road or rail line. A number of similar construction equipment is utilised and the length of time that construction activities pass any one point is of limited duration. The difference with a buried pipeline is that existing land use continues following completion of construction and rehabilitation and no segregation of previous land use activities occurs.

Construction will require a ROW along the proposed pipeline route with a width of 30 m for clearing and grading, trenching and spoil placement, stringing, pipeline welding and laying (**Figure 3-4** and **Plate 3-22**). The ROW is essential to provide access along the proposed pipeline route for pipe, personnel and supplies to construct its works. Rivers, creeks and streams will be crossed by fords, plumed crossings or bridges. These works will remain in place until the pipeline has been tested and removed during the rehabilitation phase.

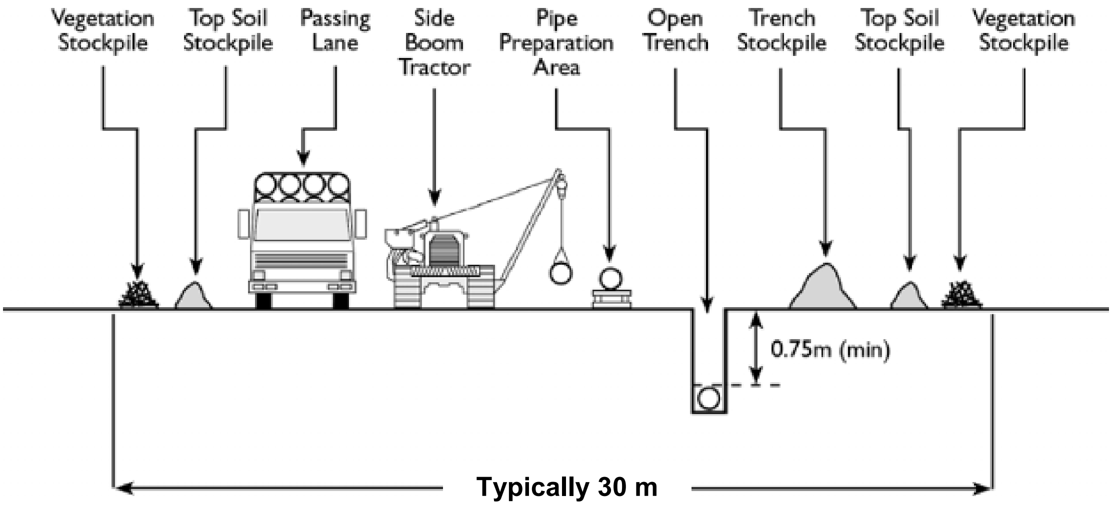


Figure 3-4: Indicative corridor layout for pipeline construction (Source: APIA Code of Environmental Practice)

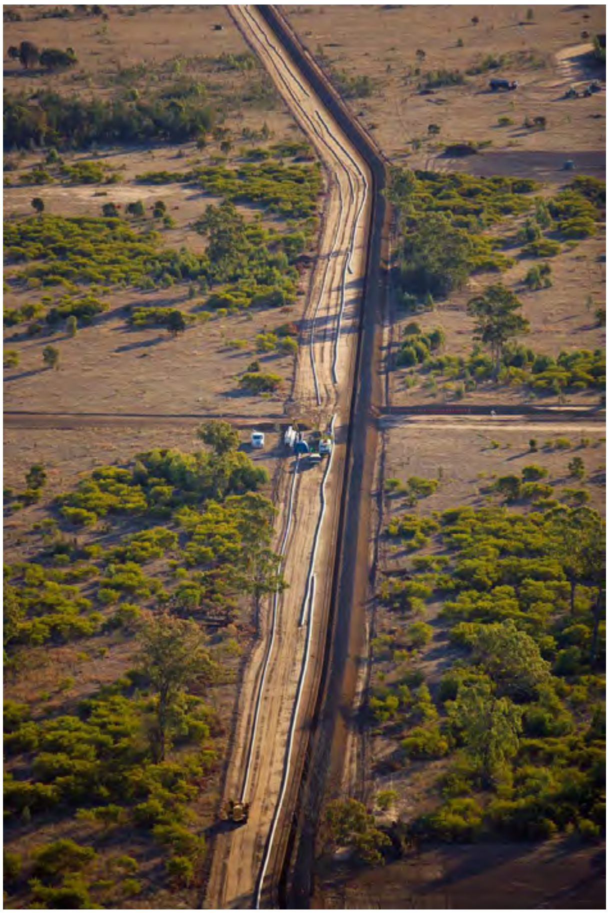


Plate 3-22: Typical pipeline ROW

3.2.1. CONSTRUCTION EQUIPMENT AND PLANT

Various plant and equipment will be necessary for construction of the pipeline including the following:

- Standard semitrailers or extendable tri-axle trailers and, where permissible, road trains (to transport two trailer loads of pipe at a time) to transport 12 m to 18 m lengths of pipe (depending on final pipeline diameter determined during detailed design) to stockpile locations along the length of the proposed pipeline route;
- Graders for topsoil stripping and levelling;
- Water trucks for dust suppression;
- Tip trucks, to transport bedding sand if required on site and excavated burden off site;
- Cranes and side booms for pipe laying;
- Excavation machinery, including excavators, bulldozers and / or specialised trenching machines;
- Mobile welding plant;
- Equipment for HDD and horizontal boring; and
- Personnel transport vehicles, including mini buses and four wheel drives.

3.2.2. ENVIRONMENTAL MANAGEMENT

The project will be managed in accordance with the project EMP developed by Arrow (**Chapter 5**) as well as subsequent EMPs to be developed with inputs from environmental consultants and the project construction contractor.

The project EMP has been developed to guide effective and responsible environmental management of the project throughout the construction and operation phase of the project. The EMP is in accordance with project commitments identified at the end of each key section of the EIS and relevant legislation (primarily the *EP Act 1994*). The EMP will also incorporate conditions imposed by DERM through the EIS process (including the EA).

3.2.3. CONSTRUCTION ACTIVITIES

3.2.3.1. Detailed survey

The pipe centreline will be surveyed and confirmed after detailed geotechnical, engineering, ecological and cultural heritage surveys are completed. Markers will be placed along the entire proposed pipeline route to identify the pipeline centreline, the ROW and any additional work spaces. It may not be necessary to peg and mark the centreline if the contractor is using accurate GPS control equipment. Vegetation boundaries will be well defined. Trees to be retained will be marked and areas of reduced ROW will be flagged. Areas outside the ROW used for extra workspace, truck turnarounds or laydown areas will be subject to appropriate heritage and environmental assessment and landholder approval prior to use.

3.2.3.2. Fencing

Prior to clearing of the surveyed ROW for construction access, fences crossing the ROW will be strained and cut and temporary gates installed where fences are required to be breached.

3.2.3.3. Clear and grade

Clear and grade (**Plate 3-23** and **Plate 3-24**) will be carried out to provide a safe construction ROW for vehicular movement, trenching and other construction activities. A width of 30 m will generally be required to enable construction to be safely and efficiently carried out. The ROW may be reduced in width for limited distances through sensitive areas. The ROW will be cleared of vegetation (although root stock will be left in the ground where practicable to stabilise the area and reduce erosion potential). Breaks will be left in stockpiled vegetation to allow continued access to stock, fence lines, tracks and drainage lines. Topsoil will be removed (typically to a depth of 100 to 300 mm) over the trenchline and the area of bulk excavation will be stockpiled separately for reuse during rehabilitation. The ROW will be levelled to the required gradient using graders, backhoes and bulldozers.

Temporary causeways over watercourses and access points to local roads will be constructed during this phase. Access track watercourse crossings (including bed level watercourse crossings), are further discussed in **Section 4.8.2.3**.

Plate 3-23: Typical grading of the ROW

Plate 3-24: Typical clearing of the ROW and avoidance of sensitive vegetation

3.2.3.4. Stringing

Stringing (**Plate 3-26**) is the term used to describe the laying out of the pipe in preparation for welding. Pipe will generally be transported to site on trucks in 12 m to 18 m lengths. The pipe will be laid out adjacent to the trench and elevated on skids and sandbags that protect the pipe coating from damage.

Where required, pipe lengths will be bent to match changes in either elevation or direction of the route using a hydraulic bending machine.

Plate 3-25: Pipeline stringing

3.2.3.5. Welding

Once the pipe is strung, a line-up crew will position the pipe using side-boom tractors and internal line-up clamps.

Specialised construction crews will undertake the welding phase of the pipeline in accordance with AS 2885.2. Pipes are typically welded either manually (as depicted in **Plate 3-26**) or via automated welding process, into strings of approximately 800 m in length, allowing for stock and landholder access breaks where necessary.

Plate 3-26: Pipeline welding

3.2.3.6. Non-destructive testing

All welds are subjected to a Non-Destructive Testing inspection (X-ray analysis or ultrasonic testing) in accordance with AS 2885.2 to check for compliance to specification, thus ensuring the structural integrity of each weld (**Plate 3-27**). Non-compliant welds are either repaired or replaced.

Plate 3-27: Non-destructive testing being conducted

3.2.3.7. Joint coating

Following welding, the weld joints will be cleaned by grinding, power wire brushing or pressure cleaning with a naturally occurring inert substance (Garnet) and an external coating (compatible with the factory applied external coating) will be applied to prevent corrosion (**Plate 3-28**).

Plate 3-28: Coating of the weld point

3.2.3.8. Trenching

A wheel trencher, rocksaw or excavator or a combination of these will be used to excavate the trench within which the pipe will be laid (**Plate 3-29**). The distance covered per day will be dependent on terrain and weather conditions, but typically on projects of this nature, a production rate of up to two km per day is anticipated.

The depth of the trench is determined by a risk assessment conducted in accordance with AS 2885.1, with the minimum depth of cover being 750 mm and 1,200 mm for creek and infrastructure crossings. Trench depth (typically 1,800 mm) depends on the current or anticipated use of the land. The trench width is typically 300 mm wider than the pipe diameter. Trench spoil is stockpiled separately to topsoil on the non working side of the ROW. The pipeline is generally laid to follow the contours of the land.

Breaks in the trench will be left where required to facilitate stock and wildlife crossing, agricultural vehicle movements and at drainage lines. In addition, methods will be adopted to minimise fauna entrapment and mortality (e.g. ramped ends of trench, safe havens). These methods will ensure that fauna egress points in the trench will be no more than 1,000 m apart. In addition, there will be breaks in the trench for tracks, watercourses, roads and buried services traversed by the proposed pipeline route.

Plate 3-29: Trenching machine in operation

3.2.3.9. Lowering-in and backfilling

Where required, the trench is prepared by placing padding (fine subsoil) at the base to protect the pipe coating from damage. Padding machines are used to generate this padding by sifting the excavated trench spoil to remove coarse materials to produce a fine substrate (**Plate 3-30**). Topsoil will not be used as padding.

Plate 3-30: Padding machine in operation

In some instances (e.g. very rocky areas) imported sand may be used, although this is not currently planned. Instead, the use of an on-site crusher to produce the appropriate padding material may be utilised. Soil extraction sites, if required, will be located close to the proposed pipeline route and subject to appropriate government and landholder approval. Excavation sites will avoid Environmentally Sensitive Areas (ESAs) and vegetation clearing will be avoided to the greatest extent possible. Following excavation, the affected areas will be re-profiled and any cleared vegetation respread to encourage natural regeneration.

The pipe coating will be inspected and tested for defects as the pipe is lifted from the skids and lowered into the trench using side-boom tractors (**Plate 3-31** to **Plate 3-33**).

Where required, impermeable trench blocks (known as trench or sack breakers) will be installed prior to backfilling of the trench 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.

Excavated material will be bladed into the trench by a bulldozer or grader. The material will be placed in layers and wheel-rolled to provide compaction and prevent subsequent settlement. Some excess spoil remains following completion of filling of the trench, however, this excess is respread within the 30 m wide ROW. Only then is the topsoil returned across the top of the ROW to return the disturbed area to its original profile.

Plate 3-31: Pipe after welding and coating before lowering-in

Plate 3-32: Pipe being lowered into trench

Plate 3-33: Pipe lowered into trench before backfilling

3.2.3.10. Hydrostatic pressure testing

Hydrostatic testing, which comprises pressure testing of a section of the pipeline with water, will be undertaken to establish the strength and leak tightness of the test section and to confirm the strength of the pipeline for the purposes of confirming the Maximum Allowable Operating Pressure (MAOP). All pipe sections will be subject to a hydrostatic pressure test (**Plate 3-34** and **Plate 3-35**).

Hydrostatic testing procedures, including water sourcing and disposal, will be determined during the detailed design and construction phase of the project. The following information is provisional only and is subject to confirmation during the procedure development and approval phase of the project.

A project specific hydrostatic test water management plan will be developed and will include, but not necessarily limited to, details of the following:

- Volume and source of hydrostatic test water;
- Additives to be used (if any);
- Any proposed holding basins;
- Proposed method and location of reuse and / or disposal of test water; and

- Proposed management measures to avoid or minimise environmental impacts associated with hydrostatic testing, including sourcing, storage, treatment, reuse and / or disposal of test water.

Plate 3-34: Hydrostatic testing in progress

Plate 3-35: Hydrostatic testing in progress

Test water

Water is normally obtained from existing sources in the area, such as property dams and local watercourses. Where required, approvals will be obtained from DERM or the owner of the water. Source and disposal options will be explored to maximise efficiency of testing, timing of construction and commissioning, as well as ensuring environmental good practice. Beneficial reuse of treated CSG water may also be considered in some locations at this time.

Hydrostatic testing water will not be extracted from significant aquatic habitat areas. Water sourced from natural waterways will be screened with a medium mesh to protect aquatic life and again with a finer mesh to limit particle size intake into the test section and flow rates and water levels will be maintained. Where hydrostatic test water is sourced from natural watercourses, it will, where necessary, be recycled to minimise future extraction and disposal volumes. Permits will be obtained where required for the sourcing of hydrostatic test water.

Alternatively, in areas where CSG is being produced, and sufficient volumes of treated CSG water of adequate quality for hydrostatic testing purposes, is available, treated CSG water will be used.

Prior to filling the test section with water, the section will be flushed with a slug of water to ensure that no construction rubbish remains that may inhibit the cleaning, drying or commissioning processes. This slug of water will be captured on release from the test section and not permitted to discharge directly to the ground. The slug of water will be collected and strained to remove any impurities and either treated through the sewerage treatment at the temporary workers‘ accommodation camps or disposed of through trade waste.

Additives, such as biocides and oxygen scavengers, may be added to hydrostatic test water, if required, to remove biological organisms and reduce corrosion potential during testing. If test water is used for more than 30 days, it may need to be treated with a combination of oxygen scavenger and biocide to ensure that corrosion attributable to bacterial, oxygen or microbial action is prevented.

Where biocides or oxygen scavengers are required, dosing concentrations will be in accordance with the manufacturer‘s recommendations and international best practice. Where reagents are required, they will be selected on the basis they degrade rapidly under aeration, or similar natural treatment.

Hydrotest water discharge

Prior to the discharge of hydrostatic test water, an evaluation will be undertaken to ensure the discharge is of similar quality as watercourse, water bodies or groundwater.

Hydrostatic test waters will not be directly discharged to natural waterways.

To prevent potential soil contamination or erosion, hydrostatic test waters will be filtered through a geotextile fabric or held in a temporary sediment retention basin in order to remove the majority of solid materials prior to discharge.

The discharge of hydrostatic test water released between pipe sections will be discharged in such a way as to prevent flooding or erosion (e.g. against a splash plate or other dispersive device to aerate, slow and dissipate the flow).

Hydrostatic test water discharge or recycling for secondary uses, such as pasture irrigation, will only be undertaken where water quality is within relevant water quality guidelines.

Test section criteria

The test section length of the pipe will be determined after consideration of:

- The permissible elevation difference;
- The estimated extent of yielding at the intended strength pressure;
- The test section volume; and
- Logistical constraints.

As stated previously, hydrostatic testing serves two purposes:

- To demonstrate that the pipeline has the strength required of it; and
- To demonstrate its leak-tightness.

The basic procedure is essentially the same for both tests and involves the pipeline section being closed off and filled with water to a certain pressure with the water being held at that pressure for a specified time.

Leak tests are carried out by observing the presence or absence of leaks, either visually or by pressure change. This method provides for a very effective detection of leaks compared with the other measurement methods and instrumentation.

Dewatering and drying

After satisfactory hydrostatic testing of a section, the section will be dewatered and dried. Swabbing / cleaning pigs (**Plate 3-36**) will be passed through the test section using oil free compressed air to achieve an acceptable criterion for dryness and cleanliness. These criteria will have been established and included in the procedures to be developed and approved prior to the commencement of hydrostatic testing.

Plate 3-36: Pipeline cleaning pigs

When clean and dry, the test section will be welded to any preceding sections and left sealed and dry in readiness for commissioning.

3.2.4. CLEAN UP, RESTORATION AND REHABILITATION

Clean up, restoration and rehabilitation measures will be applied to all areas disturbed during construction, including the ROW, access tracks and temporary workers' accommodation camp sites, as soon as practical after pipe laying and backfill. Generally, clean up and rehabilitation will involve removal of foreign material (construction material and waste), surface contouring, re-spreading topsoil, respreading vegetation and reseeding / revegetation (typically with native grass or improved pasture species).

Generally the landscape will be rehabilitated to pre-existing contours (allowing for some settling) with natural drainage lines restored and protected (if required). In certain cases, rehabilitation will be tailored to site specific conditions in consultation with the landholder. To promote vegetation regrowth and protect against the loss of topsoil, the ROW surface will normally be lightly scarified or ripped (if required) prior to respreading of topsoil.

Temporary access ways and causeways will be removed following consultation with landholders.

Rehabilitation will be undertaken in accordance with best practice and will ensure that:

- Topsoil cover is re-established and all land and waterways disturbed by project activities are returned to a stable condition as soon as practicable after construction;
- Land is returned as close as possible to its previous productivity;

- Stable landforms are re-established to original topographic contours;
- Natural drainage patterns are reinstated;
- Erosion controls (e.g. contour banks) are installed in erosion prone areas;
- The pre-construction environment is reinstated and disturbed habitats recreated;
- Fences and gates are restored; and
- Pipeline marker signs are installed.

3.2.5. WATERCOURSE CROSSINGS

The pipeline alignment crosses a number of watercourses. Access across these watercourses will be required for both pipe laying and for the movement of construction equipment. This is achieved by fords or flumed crossings.

The watercourse crossing locations are as identified in **Table 3-1**.

Table 3-1: Watercourses crossed by the proposed pipeline route

Watercourse name	Approximate KP
Certio Creek	AB4.6
Suttor Creek	AB12.3
Eagerfield Creek	AB28.3
Isaac River	AB50.2
Bullock Creek	AB67.1
North Creek	AB109.2
Isaac River	AB164.6
Stephens Creek	AB170.4
Blackburn Creek	AB171.7
Sandy Gully	AB197.8
Rolf Creek	AB212.8
Bellarine Creek	AB216.4, AB217.6
Isaac River	AB234.3
Clarke Creek	AB238.5
Clive Creek	AB249
Plumtree Creek	AB251
Coppermine Creek	AB259.6
Spring Creek	AB271.3
Pluto Creek	AB273.4, AB275.7, AB278.9, AB279.6
Apis Creek	AB284.2, AB289.1

Watercourse name	Approximate KP
Develin Creek	AB303.1
Ten Mile Creek	AB314.7, AB332.2
Fitzroy River	AB317.9, AB319.5
Seven Mile Creek	AB339.7
Six Mile Creek	AB343.9
Two Mile Creek	AB349.3
Station Creek	AB352.5
Louisa Creek	AB358.4
Limestone Creek	AB371.3
Deep Creek	AB373.4
Black Gin Creek	AB377.6
Lion Creek	AB382.8
Little Malchi Creek	AB387.4
Neerkol Creek	AB391.4
Gracemere Creek	AB395.8
Teetree Creek	AB400.1, AB400.4
Four Mile Creek	AB402.7
Gavial Creek	AB406.4
Midgee Creek	AB410.4
Casuarina Creek	AB413.6
Station Creek	AB419.2
Oakey Creek	AB419.7
Inkerman Creek	AB430.1
Twelve Mile Creek	AB438.8
Marble Creek	AB440
Pelican Creek	AB442.4
Horrigan Creek	AB445.5
Raglan Creek	AB446.6
Larcom Vale Creek	AB458.8
Larcom Creek	AB476.2
Laterals	
Walker Creek	EL4.6, EL8.4, EL10.1, EL11.7
Carborough Creek	EL28.4, EL29.2
Blackburn Creek	DL18.3, DL19.5
Ripstone Creek	SL6.4
Isaac River	SL19

To minimise the period of construction and subsequent environmental disturbance, watercourse crossings will be undertaken within the shortest period practicable. It is anticipated that construction will occur during winter months when there is less rainfall and watercourses are usually at their lowest flow level.

Common pipeline construction methods used for crossing of the watercourses include open cut trenching (including flow diversion, if applicable) and HDD.

The methodology for selecting the most appropriate watercourse crossing is outlined in **Table 3-2**.

Table 3-2: Crossing method selection

Sensitivity	Sensitivity criteria	Technique
Low	▪ Ephemeral stream (or no flow at time of construction); ▪ No threatened species habitat; ▪ In-stream habitat highly modified / disturbed; and ▪ Poor riparian vegetation, high percentage of introduced and / or weed species.	Open trench
Moderate	▪ Flow at time of construction; ▪ Some good quality in-stream habitat; ▪ Moderate riparian vegetation, with some native species present; and ▪ Downstream water users that can tolerate temporary increased sediment load.	Open trench with flow diversion
High	▪ High flow at time of construction; ▪ Threatened species habitat present; ▪ Known presence of threatened species; ▪ Near natural / excellent in-stream habitat; ▪ Good intact native riparian vegetation; and ▪ Highly sensitive downstream water users.	HDD or flow diversion with site specific mitigation measures

3.2.5.1. Dry rivers, minor creeks and streams

Where possible, crossings will be constructed while the watercourse is dry using the open cut trenching method. If water flow is present, it will be transported across the trench via flume pipes or, alternatively, the watercourse will be temporarily dammed and the water flow pumped around the crossing site.

Standard open cut / flow diversion

The majority of watercourse crossings are expected to be constructed using standard open cut (trenching) construction, as illustrated in **Plate 3-37** to **Plate 3-39**. This technique is most suited for dry or low flow conditions. It involves establishing a stable working platform either side of the watercourse and creating a trench using excavators. Tie-in points will be located on high ground well away from any water flow.

Plate 3-37: Open cut construction of watercourse crossing

Plate 3-38: Open cut construction of watercourse crossing

Plate 3-39: Open cut construction of watercourse crossing

Trench spoil removed from the watercourse will be placed above the bank. Trench and backfill activities will be undertaken to ensure that bed and bank material is stockpiled separately and returned to the trench to match original conditions.

The pipe to be used for watercourse crossings and in areas of significant inundation (as identified by risk assessment in compliance with AS 2885.1) may be concrete coated to give negative buoyancy.

Welded pipe will be laid in the trench and spoil material returned to the trench. Rock protection will be placed over the trench in the stream bed where required, to prevent potential scouring during high water flow conditions.

Flow diversion is a modification of the standard open cut method where higher water volumes and flows (typically <1,000 L/s) are present. Techniques include:

- Concentrating the flow through a flume pipe to prevent siltation problems that may be created during trenching, lowering in and backfilling (not suitable for watercourses with broad channels, low gradients and permeable substrates); and
- Pumping water around the work area by constructing barrier dykes / head walls above and below the trenched area keeping the work area relatively dry (suitable for low gradient streams with a discharge < 1,000 L/s).

If access is required across the watercourse, the water is directed through a diversion pipe and a causeway constructed over the watercourse to allow the passage of construction traffic. Refer to **Section 4.5**.

An example of flow diversion is illustrated in **Plate 3-40**.

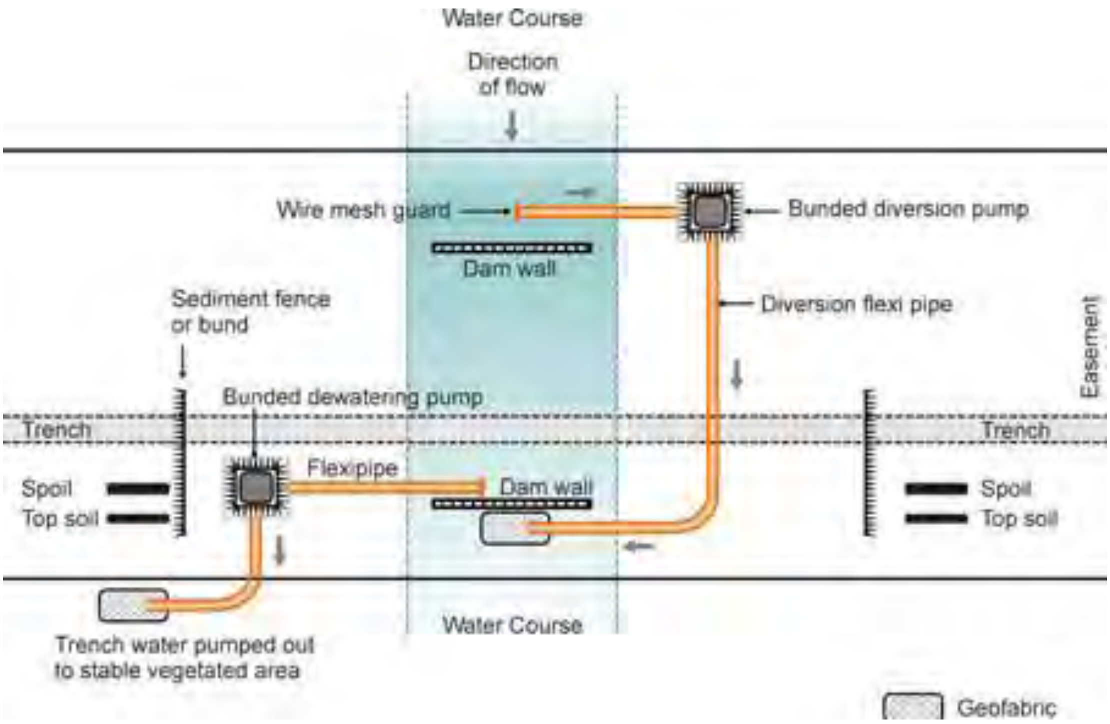


Plate 3-40: Example of flow diversion if required

Watercourse banks will be reinstated as near as practicable to their original profile. Where required, geofabric (for example, jute matting), which remains permeable to water and enhances plant growth, will be used to hold soil in place during re-establishment. Vegetation is then reinstated, usually involving initial seeding with sterile grasses (for example, millet or rye corn) to facilitate revegetation and stabilisation of watercourse banks. Subsequent revegetation of the crossing will aim to re-establish native plant species through natural regeneration and / or seeding. Rehabilitation of the ROW across a watercourse is illustrated in **Plate 3-41** and **Plate 3-42**.

Following construction, reinstatement will be monitored and access may be restricted to facilitate rehabilitation.

Plate 3-41: Rehabilitation of ROW across a watercourse

Plate 3-42: Rehabilitation of ROW across a watercourse

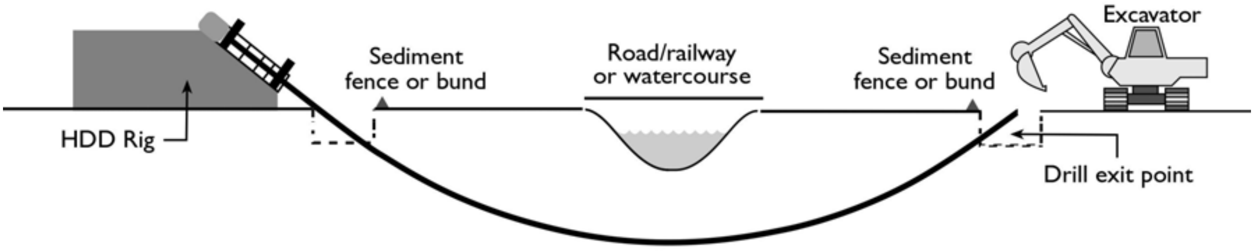
3.2.5.2. Permanent flowing waterways

Permanent flowing watercourse crossings may be constructed using the HDD technique in which a hole is drilled under the watercourse bed and the pipeline section is pulled through the hole.

This HDD technique is being considered for crossing the Fitzroy River and parts of the Isaac River and Raglan Creek subject to geotechnical verification.

Horizontal Directional Drilling

Whilst HDD, illustrated in **Plate 3-43** and **Plate 3-44**, is generally used to cross major watercourses, it may also be used for crossings of some roads or railways.



(Source: APIA Code of Environmental Practice)

Plate 3-43: Typical illustrative HDD

Plate 3-44: Horizontal directional drilling under a watercourse

A detailed geotechnical investigation to determine site suitability will be required as the use of HDD is governed by site conditions, such as stability, slope, access, available workspace and nature of subsurface ground conditions. The size of the HDD rig and associated footprint depends on the size of the pipe, subsurface geology and the length of the drill.

Installation of the proposed pipeline by HDD involves drilling a tunnel beneath the surface and the pipe is then pulled through. A purpose designed drill rig, operated by a specialist contractor, will be used. Drilling mud (typically bentonite) is used to hydraulically drive the drilling head, as a coolant, to wash the drill cuttings to the start of the drilled hole and to seal and line the hole to facilitate insertion of the pipe. The bentonite is screened and recycled or buried in the trench.

Once the pipe string is installed and tied into the main section of the pipeline, the entry and exit points are remediated and excess material disposed of in the trench or at an approved disposal site.

3.2.6. ABOVE GROUND FACILITIES

Above ground structures will be situated at intervals along the proposed pipeline route and will include cathodic protection posts, main line valves, scraper stations and a gas hub at the end of the proposed pipeline. Typically these facilities will be located within the 30 m wide easement and will be protected by fencing. Pipeline markers are placed along the route in accordance with AS 2885.1.

Plate 3-45: Pipeline marker

3.2.7. CONSTRUCTION TIMING

At this stage in project planning, it is envisaged that the pipeline will be constructed over the course of 15 months, commencing in April 2016 and undertaken over the 2016 and 2017 dry seasons. However, circumstances such as adverse weather and potential collaboration with other pipeline construction projects in the same region could extend the proposed construction period. Operation of the pipeline is planned to commence in 2017.

It is proposed to award the contract for pipeline construction following FID. The contractor will have the responsibility for development of a detailed construction schedule that meets the completion deadline.

3.2.8. COMMISSIONING

Following completion of hydrotesting (**Section 3.2.3.10**), the pipeline will be commissioned. Commissioning will proceed sequentially from the point where commissioning gas is available and subsequently on completion of the nominated sections.

Commissioning will be in accordance with a procedure prepared during the detailed design and construction phase of the project. The following information is provisional only and will be confirmed during the development and approvals phase of the project.

Commissioning activities referenced within the scope of the procedure will include the following major terms:

- Evidence of pre-commissioning of pipeline, including all construction records, hydrostatic testing, cathodic protection, instrumentation and supervisory control and data acquisition systems; and
- Commissioning of the pipeline, involving:
  - Creating a nitrogen ‗slug' to separate the CSG for air in the pipeline[5];
  - Low pressure CSG fill;
  - Final high pressure fill to limit of gas availability;
  - Commissioning checks and performance tests; and
  - Punch listing of defective items.

The initial CSG fill will be preceded by the introduction of a slug of an inert gas, typically nitrogen and a number of foam pigs to separate the air present in the pipeline after

[5] Purging described the process in which air is removed from the pipeline prior to the introduction of CSG to ensure safe entry of the CSG

construction and the CSG, thereby preventing the likelihood of a potential explosion due to any air / gas mixture.

During purging, air will be discharged from the downstream end of the section being commissioned (typically at a line valve) followed by the nitrogen slug and then CSG. As there is some mixing of the slugs, the CSG initially contains some nitrogen. Venting will continue until pure CSG is detected at the outlet (valve), after which the section will be locked in and the pressure increased until the required pressure is reached.

Volumes of gas discharges at this time are very small as most of the discharge is at pressures just slightly above atmospheric pressure and the mixing only occurs over short lengths.

The low pressure fill enables leak testing at low pressures to be undertaken prior to the pipeline reaching full line pressure.

The commissioning process will have the following limited environmental impacts:

- The limited release of natural gas and nitrogen to the environment;
- The major component of natural gas, methane, is a greenhouse gas with an effective multiplier of 20 times that of carbon dioxide. The Material Safety Data Sheet (MSDS) for nitrogen states that it does not contribute to ozone depletion or global warming. The atmosphere already contains approximately 80% nitrogen and thus the addition of small existing volumes is not considered detrimental;
- Intermittent noise from nitrogen / gas venting; and
- Minor dust release from venting.

At the completion of commissioning, the pipeline will have been purged and filled with gas to a pressure determined by the Commissioning Manager and will be ready for operation.

3.3. OPERATIONS

The operation of the pipeline will be in accordance with approval documentation, a specific operation EMP, AS 2885 and the APIA Code (APIA 2009).

The pipeline will be a high integrity pipeline constructed from high strength steel and integrity tested by 100% examination of welds and a high pressure hydrostatic test at pressures in excess of the MAOP. Operational activities will ensure that this integrity is maintained over the life of the project.

During operation, a pipeline easement of 30 m will be maintained. Following reinstatement and revegetation of the ROW, very little above ground infrastructure will be visible.

A typical enclosure around a valve is illustrated in **Plate 3-46**.

Plate 3-46: Typical enclosure around a valve on a rural property

With the possible exception of scraper stations, it is anticipated that all above ground facilities will be fully contained within the 30 m wide pipeline easement.

OPERATIONAL ACTIVITIES

A summary of operational activities is provided in **Table 3-3**.

Table 3-3: Summary of pipeline operational activities

Activity / issue	Description / management
Weed control	Localised weed spraying (in consultation with landholders) is undertaken along the easement as required (primarily in the first 12 months following commissioning) and forms a key part of ongoing maintenance of the project site.
Line of sight clearance	Clearance of the pipeline easement within three metres of the proposed pipeline centreline to maintain line of sight will be required as shrubs and trees regenerate within 3.5 m of the proposed pipeline centreline. Regeneration of shrubs and trees elsewhere on the easement will be encouraged to preserve continued pipeline integrity.
Aerial inspection of easement	Inspections may be undertaken using rotary or fixed-wing aircraft, particularly in areas where only limited public road access is available. Frequency will vary depending upon the particular issue being inspected, but is typically monthly or quarterly.
Patrolling / inspections easement access	This will be undertaken, in conjunction with aerial inspections, by travelling along the project site in vehicles on an as-needed basis. This will involve access to private property and use of private access tracks.

Activity / issue	Description / management
Pipeline operations	
Cathodic protection surveys	Surveys involve travelling the pipeline easement and stopping to measure cathodic protection point output. Typically conducted annually. Depending upon the results detected, this may also involve coating repairs – refer to ‗excavations'.
Testing and inspection valves	Valves will be operated to ensure their availability in the event of an emergency. Extremely small volumes of gas may be released during this activity as the valves are likely to be powered by the pressure in the pipeline. Typical frequency is annually.
Erosion repair	Following major rainfall events, the pipeline easement will be subject to aerial inspection (particularly during the first 24 months after commissioning) to determine if any areas have suffered from erosion or subsidence. Any areas detected will be repaired immediately to match existing ground contours.
Emissions	Throughout the lifetime of the project, small amounts of gas may be released to the atmosphere under controlled conditions during pipeline and facility maintenance.
Pipeline incident	The main threats to public safety during 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 (external) corrosion. All identified threats presenting an unacceptable level of risk will be mitigated through adoption of AS 2885. The pipeline will also be constructed and operated according to the Pipeline Protection Safety Measures contained in the approved Safety and Operating Plan and in accordance with an approved Emergency Response Plan.
Pipeline maintenance	
Coating integrity surveys	Immediately after commissioning, and generally in conjunction with the annual cathodic protection surveys referred to above, a coating conductance test (Direct Current Voltage Gradient survey) will be carried out to determine if there are any defects in the external pipe coating that might compromise the continued long term integrity of the pipeline. Where these readings indicate that such defects cannot be controlled by the cathodic protection system, the section will be excavated and the pipeline coating repaired.
Pigging	Pigging is periodically undertaken to assess the continued integrity of the pipeline. An ‗intelligent pig' (**Plate 3-47**) is placed into the pipeline at a launcher station and is propelled through the pipeline by the gas flow before removal at a pipeline receiver station. This pig detects any damage to the pipeline and is used to direct repairs if significant damage is detected. Minor venting of gas to the atmosphere results during pig removal.

Activity / issue	Description / management
Excavations, including coating refurbishment, installation of anode beds, emergency response exercises and new tie-ins	Excavations of the proposed pipeline follow the same processes as those identified in **Section 3.2**, namely clear and grade, trenching, backfill and restoration and rehabilitation but are on a much smaller scale. 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, non-destructive testing, blast cleaning and painting/coating. Once complete, the trench is then backfilled, the ground surface re-contoured and topsoil respread. Some reseeding may also be undertaken if needed. These activities are expected to be very rare during the operational lifetime of the pipeline.
Replacement of pipeline section	The pipeline is isolated and a controlled release of gas may be required from the affected section. The affected area is then excavated, the old pipe removed and a new section installed – this includes welding, blasting and coating. This is expected to be a particularly rare event during the operational lifetime of the proposed pipeline.
Welding	Welding is usually only required during pipeline repairs or when modifications to existing infrastructure may be required. Pipeline welding requires excavation of the pipeline as described under excavations earlier in this table.
Coating	Heat shrink sleeves or tape are expected to be applied to effect coating repairs occasioned during any of the above repair work.
Pressure testing	When a section of pipe is replaced, a section of pre-tested pipe, from stock held for this purpose, is used. Where a facility is installed that has to tie-in to the pipeline, additional sections will generally be pre-tested prior to installation.
Facility operation and maintenance	
Gas hub	The proposed GGH is where the pipeline will join with the ASP. It will consist of pipeline isolation valves and scraper station plus an interconnector. These operate continuously.
Scraper station	A facility for the launching and receiving of pipeline pigs.
Weed control	Localised weed spraying is undertaken in and around above ground facilities typically one to two times per year.
Production of hazardous wastes	Waste hydrocarbons are generated from maintenance / pigging operations.
Waste disposal	General waste generated during operations is collected on site and removed to licensed facilities for disposal as outlined in **Section 4.4**.
Station blow downs	All venting during emergency situations is controlled by Emergency Response Procedures.

Plate 3-47: Intelligent pig

Operation and maintenance program

A routine operation and maintenance program will include leak detection surveys, ground and aerial patrols, pigging and cleaning of the proposed pipeline, corrosion monitoring and remediation and easement maintenance. Aerial and / or ground inspections will monitor vegetation (including presence of weed species), erosion and subsidence and rehabilitation of the ROW.

All gas flows will be metered with high accuracy metering. This information will be checked against the volume of gas within the proposed pipeline and any significant imbalance will be investigated as indicative of a potential leak after metering errors have been ruled out.

The pipeline pressure will be continuously monitored for any significant rate of change that could indicate a major leak. Pipeline valves on either side of the suspected leak locations will close automatically on detection of an excessive rate of change in pressure allowing individual sections to be isolated for subsequent inspection and testing.

Prevention of damage due to third party activity will be achieved through appropriate depth of cover, signposting of the pipeline, one-call ‗Dial Before You Dig' programs, extensive and continuous landholder and other stakeholder liaison, regular inspection of the pipeline easement to detect any construction or earthmoving activities in the area, and third party education on the potential dangers of carrying out excavation and fencing activities (sinking deep posts for fencing) in proximity to the pipeline. Underground operational pipelines generally have minimal environmental or landholder impact.

In some areas, such as crossings, additional protection may be incorporated to reduce the risk of third party interference (e.g. marker tape buried above the pipeline, physical barriers or thicker wall pipe). The buried pipe will have a minimum wall thickness of 11.2 mm, which provides a high resistance to penetration.

Heavy wall pipe, security fencing, gates and locks will be provided around all pressurised above-ground facilities (e.g. valves) to protect against accidental damage or unauthorised tampering.

External pipeline corrosion will be prevented by an external protective coating and a cathodic protection system. The cathodic protection system will be checked regularly to ensure that the protection voltages are within the limits required to protect the pipeline from corrosion at any points of coating damage. The cathodic protection system and external coating system function independently to protect the pipeline from corrosion. The internal surface of the pipeline is protected from corrosion as the transported gas is a non-corrosive dry gas, consisting mostly of methane with minor amounts of nitrogen and carbon dioxide.

Due to the pipeline being underground, land users will be able to resume previous land use activities over the pipeline easement with the only limitations generally being with regard to excavation and building activities on the 30 m wide easement itself.

The planting of deep-rooted vegetation such as trees will be discouraged approximately 3.5 m either side of the centreline due to the need for continued access along the pipeline, however grass and cropping will be encouraged to re-establish a stable surface along the easement.

A company contact number (1800 number) will be displayed on all pipeline markers and advertised locally so that third parties can contact the pipeline operators for advice or emergency response.

Access to the pipeline easement will be necessary to follow up issues identified from inspections. Inspection for erosion, subsidence and weeds will be undertaken, particularly during the first twelve months following commissioning.

Light vehicle access will be required along the pipeline easement to allow inspection and maintenance. However, existing access tracks will be utilised wherever possible.

More significant maintenance activities, such as excavation to address coating defects, are likely to be infrequent. However, all maintenance activities that are required will be conducted in accordance with an approved operation EMP. This EMP will be developed in collaboration with relevant stakeholders. Excavation of material from around the pipeline (typically referred to as a bell-hole) will be undertaken to allow sufficient room for operations technicians to safely undertake required remedial works.

The excavation of material will be undertaken in accordance with management conditions specified for construction, including separate stockpiling of topsoil from trench spoil and restoring the site as soon as practical following completion of maintenance work.

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

3.3.1. TENEMENTS AND TENURES

The proposed pipeline route currently crosses 232 lots and 90 easements within the Bowen Basin. A list of RPDs for these lots is included in **Appendix 4.8**, **Volume 3**.

The proposed pipeline route crosses a number of granted mining and petroleum tenements including Petroleum Leases (PLs), Petroleum Pipeline Licences (PPLs) and Mining Leases (MLs) as identified in **Table 3-4**. The proposed pipeline route also crosses a number of mining and petroleum tenements still within the application phase (i.e. not yet granted). The mining and petroleum tenements (granted and under application) are illustrated on **Map 2**, **Volume 2**.

Table 3-4: Tenement holders

Tenement type	Tenure no.	Principal holder	Location
PL	223	CH4 Pty Ltd	EL49
PL	191	CH4 Pty Ltd	AB69
PL	223	CH4 Pty Ltd	AB90
PPL	121	Central Queensland Pipeline Pty Ltd	SL1
PPL	88	Stanwell Corporation limited	AB395
PPL	121	Central Queensland Pipeline Pty Ltd	AB463
PPL	121	Central Queensland Pipeline Pty Ltd	AB470
PPL	121	Central Queensland Pipeline Pty Ltd	AB476
PPL	30	Jemena Queensland Gas Pipeline (1) Pty Ltd	AB478
PPL	30	Jemena Queensland Gas Pipeline (1) Pty Ltd	AB409
PPL	154	QCLNG Pipeline Pty Ltd	AB470
PPL	163	Australia Pacific Gladstone Pipeline Pty Ltd	AB470
ML	70109	Peabody (Burton Coal) Pty Ltd	AB74
ML	70338	Vale Australia (CQ) Pty Ltd	AB76
ML	70290	Coppabella Coal Pty Ltd	AB100
ML	70355	Coppabella Coal Pty Ltd	AB111
ML	7629	Cement Australia (Queensland) Pty Limited	AB478

The tenure of lots traversed by the project is summarised in **Table 3-5** and illustrated in **Map series 3**, **Volume 2**.

Land tenure traversed by the proposed pipeline route has been identified through use of the Digital Cadastral Data Base (DCDB) Tenure Codes obtained from DERM (July, 2011). In Queensland, land tenure includes two broad tenure types including freehold and non-freehold. In general terms, freehold land refers to land purchased from the State and affords the titleholder the highest level of independence in terms of land use and possession.

Table 3-5: Tenure of land impacted by the project

Type of tenure	Lots
Mainline	
Freehold	195
Land Lease	19
Reserve	4
Easement (road/rail/water)	87
TOTAL	**305**
Laterals	
Freehold	10
Land Lease	4
Easement (road/rail/water)	3
TOTAL	**17**

3.3.2. WORKFORCE

The project is anticipated to require a workforce of approximately 693 people during construction, 10 people during commissioning and decommissioning and 15 people during operation. A breakdown of the expected workforce required for each stage of the project is provided in **Table 3-6**.

Table 3-6: Breakdown of workforce required for the project

Workforce	Construction	Commissioning	Operation	Decommissioning
Administration	14	1	3	1
Automatic ultrasonic operator	10	0	0	0
Catering / janitorial	34	0	0	0
Chainmen	7	0	0	0
Clients engineers	10	0	0	0
Cultural heritage monitor	10	0	0	0
Diesel mechanic	23	0	0	0
Electrician	4	0	0	0
Engineers / surveyors	14	0	0	0
Environmentalist	4	0	0	0
Foremen	22	0	0	0
Hydrotesting personnel	20	0	0	0

Workforce	Construction	Commissioning	Operation	Decommissioning
Joint coater	14	0	0	0
Labourer	168	2	0	2
Land liaison	4	0	1	0
Paramedics	3	0	0	0
Pipeline welder	35	0	0	0
Plant operator	128	0	0	0
Professional	0	2	3	2
QA inspector	26	0	0	0
Safety inspector	6	1	0	1
Sub-contractor	0	0	0	0
Technical	0	4	8	4
Trades assistant	39	0	0	0
Traffic control	10	0	0	0
Truck driver	58	0	0	0
Welding technician	5	0	0	0
HO visitors	5	0	0	0
JV (Shell/PetroChina) personnel	10	0	0	0
Pipe transport personnel	10	0	0	0
TOTAL	**693**	**10**	**15**	**10**

An analysis of the existing workforce in the project area as well as the anticipated basis of employment for the project is provided in **Section 4.12** and in the *Economic Assessment* included in **Appendix A4.1**, **Volume 3**.

3.3.3. WORKFORCE ACCOMMODATION

Temporary workers' accommodation camps will be located along the proposed pipeline route for workers to live in during the construction phase of the project. Although there is an anticipated construction workforce of 693 people for the project (**Section 3.3.2**), each temporary workers' accommodation camp will allow for approximately 400 people, with two camps operational at any one time. A total of five temporary workers' accommodation camps are expected to be required over the life of the project. It is intended that each temporary workers' accommodation camp locations will be relocated along the proposed pipeline route as the worksite passes beyond the area to be served. Each temporary workers' accommodation camp will provide for workers laying pipe for up to 50 km either side of the camp.

Five temporary workers' accommodation camps will be located in the vicinity of the proposed pipeline route at approximately 100 km intervals as shown in **Figure 3-5**. The temporary workers' accommodation camps are expected to be located as follows:

- Temporary workers' accommodation camp 5 – Red Hill;
- Temporary workers' accommodation camp 4 – Daunia;
- Temporary workers' accommodation camp 3 – Hillcrest;
- Temporary workers' accommodation camp 2 – Foresthome; and
- Temporary workers' accommodation camp 1 – Bajool.

Development approval for the camps will be required and will be assessed separately to the EIS as full details of their construction and operation are not known at this time. The general location of each temporary workers' accommodation camp will be chosen having regard to:

- Suitability of site: no environmentally significant species or cultural heritage significance present, suitability of soil for sewage effluent disposal and high expectations for successful rehabilitation;
- Acceptance: local government authority preparedness to issue development application to cover erection and landholder acceptance;
- Access: the temporary workers' accommodation camp will require all-weather road access (for transport, food and water supplied, personnel access/egress etc);
- Proximity to the ROW: the temporary workers' accommodation camp will need to be located as close to the ROW as possible;
- Separation from flood prone areas: the temporary workers' accommodation camp will need to be located outside of flood prone areas; and
- Separation from habitation: the temporary camps will be located a minimum of 3 km from residences.

Each temporary workers' accommodation camp will be self-contained and include facilities for workers. They will include a kitchen, toilets and gym and are intended to be a wet mess (licensed) meaning alcohol will be provided on site for the consumption by the workers staying at the camp. Catering for the temporary workers' accommodation camps will be contracted to a catering company and it is anticipated that all fresh produce e.g. milk and bread will be purchased in bulk from local regional townships.

Each temporary workers' accommodation camp will be provided with approximately 100 car parking spaces, workshops, stores and laydown areas. The total expected footprint of each temporary workers' accommodation camp is approximately 250,000 m^2. Typically two temporary workers‘ accommodation camps will co-exist. The first camp constructed will be relatively small, accommodating the clear and grade, stringing and possibly the trenching crews. As this main camp is further developed to accommodate other crews, the next camp will be established to cater for them as they move along the proposed pipeline route.

The temporary workers‘ accommodation camps will require power generation, sewage treatment and a potable water supply. The temporary workers‘ accommodation camps are likely to include offices, construction depots, lay down areas and workshops. Approval for temporary workers‘ accommodation camps will be sought later in the planning process under the relevant planning scheme and under the IDAS pursuant to the SP Act, Approval for ERAs will be sought from DERM.

Examples of typical temporary workers‘ accommodation camps are provided in **Plate 3-48** to **Plate 3-49**.

ARROW BOWEN PIPELINE PRELIMINARY ROUTE (REV D)

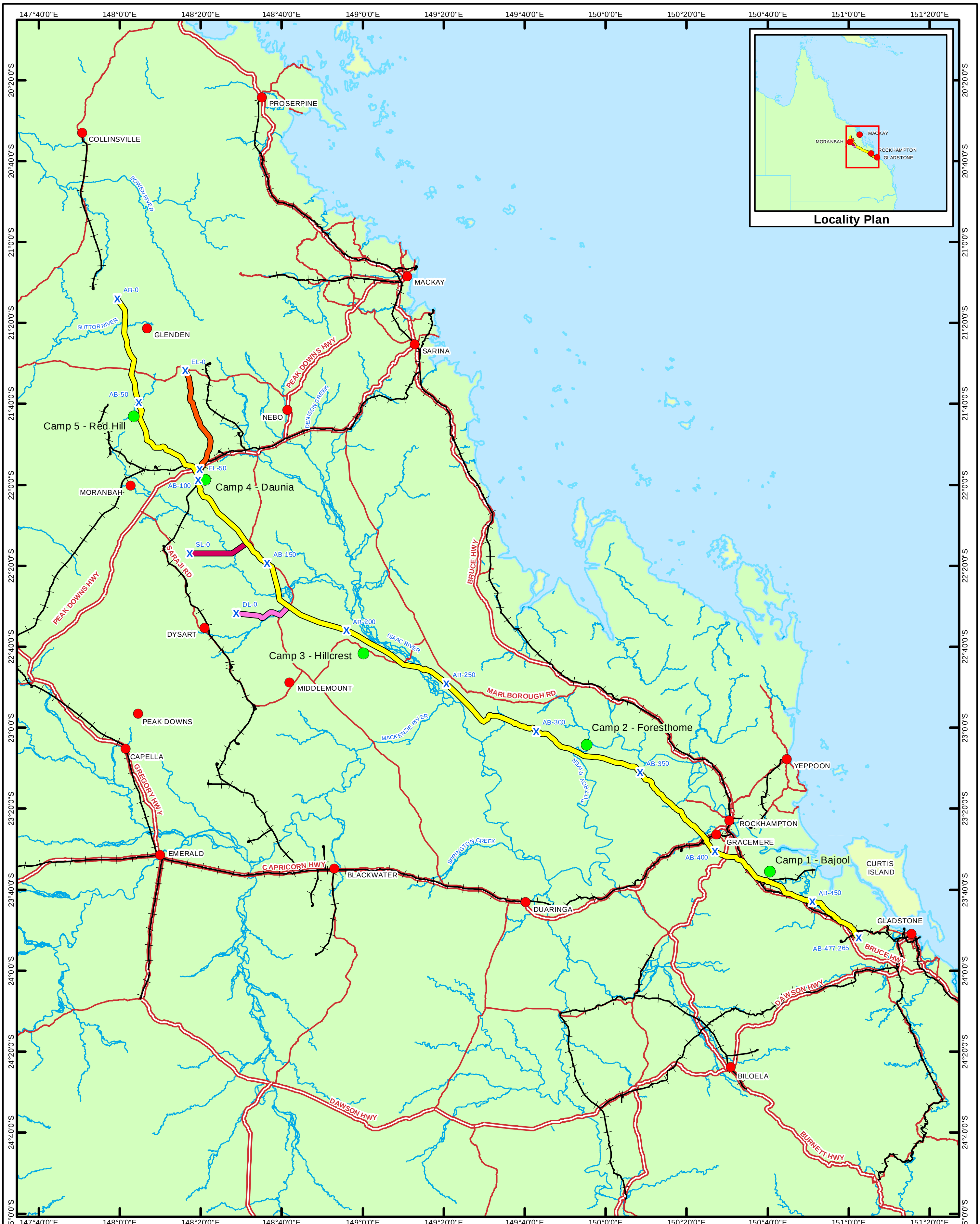


Figure 3 - 5: Indicative temporary worker accommodation camp locations

Legend

- Indicative temporary worker accommodation camp locations
- Localities
- Kilometre Points
- AB Mainline Rev D
- Dysart Lateral Rev D
- Elphinstone Lateral Rev D
- Saraji Lateral Rev D
- Railways
- Highways
- Major Roads
- Major Watercourses

Data Sources:
StreetPro: Localities, Roads, Railways
DERM: Major Watercourses
Data Supplied by Arrow Energy:
ABP Mainline RevD,
ABP Lateral RevD
Kilometre Points
Data Digitised by SKM:
Indicative Temporary Workers
Accommodation Camp Locations

N

arrow energy
go further

0 25 50
Kilometres

Scale: 1:2,250,000 @ A4
Coordinate System: GCS GDA 1994

Document: I:\ENVR\Projects\EN02962\Spatial\ArcGIS\V1\Figure_3_5_Indicative_temporary_camp_locations_A4.mxd Date: 1/03/2012

NOT FOR CONSTRUCTION

Plate 3-48: Typical temporary workers' accommodation camp

Plate 3-49: Typical temporary workers' accommodation camp

Plate 3-50: Typical temporary workers' accommodation camp (example)

3.4. INFRASTRUCTURE REQUIREMENTS

3.4.1. TRANSPORT – ROAD/RAIL/AIR/SHIP

Transport will be required for activities associated with the construction phase of the project when plant, equipment, materials, temporary workers' accommodation camp facilities and personnel are moved to and from work sites and for the operation phase where personnel and specialist vehicles are required for site assessment, inspection and maintenance works.

The pipeline construction will involve the initial delivery of plant and equipment (e.g. graders, bulldozers and welding units) and temporary workers' accommodation camp facilities as well as daily movements associated with construction workers and pipe deliveries.

As there are no manufacturers capable of producing the pipe in Australia at this time, pipe for the project is expected to be manufactured and coated offshore and delivered to Australia in 20,000 dead weight tonne vessels via the Port of Mackay and the Port of Gladstone. A total of 200,000 dead weight tonnes of pipe will be imported for the project. Ships are likely to deliver the loads every four weeks and the pipe will be then transported directly to the project area or the temporary workers' accommodation camps where it will be stockpiled.

Details of transport requirements are provided in **Section 4.3** and in the *Transport Impact Assessment* in **Appendix A4.5**, **Volume 3**.

3.4.1.1. Major road crossings

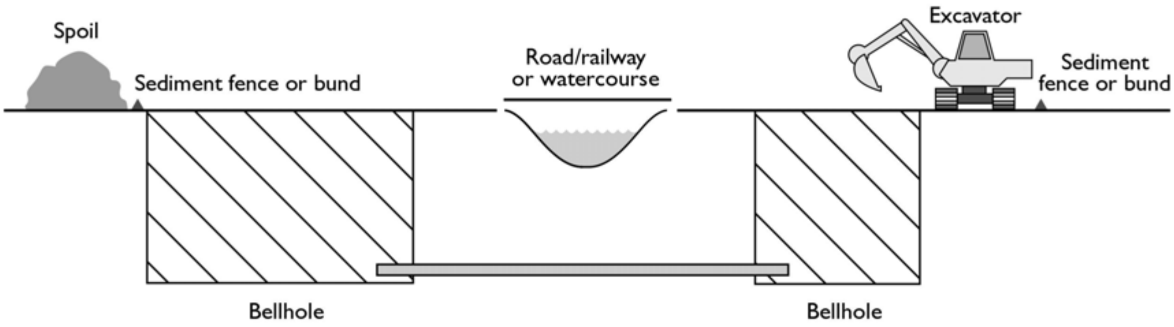
The Bruce, Peak Downs, Burnett and Capricorn Highways are among the more significant of the roads traversed by the proposed pipeline route.

The major formed roads that will be traversed by the proposed pipeline route are identified in **Table 3-7** and illustrated in **Map series 8**, **Volume 2**.

Table 3-7: Major formed roads traversed by the proposed pipeline route

Road name	LGA	Approximate KP
AB Mainline		
Newlands Access Road	Isaac Regional Council	AB11.5
Suttor Developmental Road	Isaac Regional Council	AB34.7
Peak Downs Highway	Isaac Regional Council	AB95.0
Carfax Road (Dysart Connection Road)	Isaac Regional Council	AB165.5
Fitzroy Developmental Road	Isaac Regional Council	AB173.0
May Downs Carfax Road	Isaac Regional Council	AB195.4
May Downs Road	Isaac Regional Council	AB228.1
Manly Access Road	Isaac Regional Council	AB254.7
Duaringa - Apis Creek Road	Rockhampton Regional Council	AB284.7
Clifton Road	Rockhampton Regional Council	AB291.8
Capricorn Highway	Rockhampton Regional Council	AB393.0
Burnett Highway	Rockhampton Regional Council	AB405.0
Bruce Highway	Rockhampton Regional Council	AB416.4
Bajool - Port Alma Road	Rockhampton Regional Council	AB431.4
Gladstone - Mount Larcom Road	Gladstone Regional Council	AB471.1
Laterals		
Peak Downs Highway	Isaac Regional Council	EL47.6

Crossings of sealed roads will be undertaken by utilising thrust boring or micro-tunnelling beneath the road (**Figure 3-6** and **Plate 3-51**). This will eliminate the need to close the road and traffic will be able to flow at all times. Traffic and safety management procedures will be implemented during this work to ensure that users are aware of the activity and conditions are safe.



Source: APIA Code

Figure 3-6: Illustration of a typical thrust bore

Plate 3-51: Thrust bore under road

3.4.1.2. Minor roads and tracks

Minor roads and tracks will be undertaken utilising open cut methods generally perpendicular to the road or track. Construction will be timed to minimise disruption to users and where required, side diversion tracks will be constructed or road plates used to minimise impacts to traffic flow. Traffic and safety management procedures will be implemented to ensure that users are aware of the activity and conditions are safe. The named minor roads and tracks traversed by the proposed pipeline route are identified on **Map series 8**, **Volume 2** and in **Table 3-8**.

Table 3-8: Minor roads and tracks traversed by the proposed pipeline route

Road / track name	LGA	Approximate KP
Red Hill Road (Lenton Downs Red Hill Road)	Isaac Regional Council	AB50.5
Daunia Road	Isaac Regional Council	AB100.5
Annandale Road	Isaac Regional Council	AB109.4, AB112.0, AB119.0
Iffley Connection Road	Isaac Regional Council	AB136.9
Glenroy Marlborough Road	Rockhampton Regional Council	AB316.6
Redbank Road	Rockhampton Regional Council	AB327.0
Fairview Road	Rockhampton Regional Council	AB338.0
Glenroy Road	Rockhampton Regional Council	AB351.0
Craignaught Road	Rockhampton Regional Council	AB355.8
Mornish Road	Rockhampton Regional Council	AB357.9
Faraday Road	Rockhampton Regional Council	AB363.1
Dalma Ridgelands Road	Rockhampton Regional Council	AB365.4
Stanwell Waroula Road	Rockhampton Regional Council	AB372.0
Harding Road	Rockhampton Regional Council	AB375.2
Tucker Road	Rockhampton Regional Council	AB379.9
Cunningham Road	Rockhampton Regional Council	AB382.0
Hopper Road	Rockhampton Regional Council	AB390.7
Kabra Scrubby Creek Road	Rockhampton Regional Council	AB391.7
Somerset Road	Rockhampton Regional Council	AB393.1
Boongary Road	Rockhampton Regional Council	AB395.1
Mogilno Road	Rockhampton Regional Council	AB410.7
Mclean Road	Rockhampton Regional Council	AB412.5
Toonda Port Alma Road	Rockhampton Regional Council	AB433.1

Road / track name	LGA	Approximate KP
Twelve Mile Road	Rockhampton Regional Council	AB438.8, AB442.3
Reedy Creek	Gladstone Regional Council	AB455.0
Darts Creek Road	Gladstone Regional Council	AB462.0
Popenia Road	Gladstone Regional Council	AB465.5
Gostevsky Road	Gladstone Regional Council	AB467.5
The Narrows Road	Gladstone Regional Council	AB469.7

3.4.1.3. Stock route crossings

Stock routes that will be traversed by the proposed pipeline at right angles are outlined in **Table 3-9**. There will be no permanent disruption to the stock route network.

Table 3-9: Stock routes traversed by the proposed pipeline route

Route name	LGA	Approximate KP
Newlands Access Road	Isaac Regional Council	AB11.5
Suttor Developmental Road	Isaac Regional Council	AB34.7
Carfax Road (Dysart Connection Road)	Isaac Regional Council	AB165.5
May Downs Road	Isaac Regional Council	AB228.1
Duaringa - Apis Creek Road	Rockhampton Regional Council	AB284.7
Clifton Road	Rockhampton Regional Council	AB291.8

3.4.1.4. Railway crossings

A total of seven railway lines (including one disused and one proposed) will be traversed by the proposed pipeline route as identified in **Table 3-10**.

Table 3-10: Railways traversed by the proposed pipeline route

Railway name	LGA	Approximate KP
Goonyella Branch Railway Crossing	Isaac Regional Council	AB90.1, EL47.0
Norwich Park Branch Railway Crossing	Isaac Regional Council	AB100.1
Central Line Crossing	Rockhampton Regional Council	AB393
North Coast Railway Crossing	Rockhampton Regional Council and Gladstone Regional Council	AB416.5, AB471.0
East End Mine Branch Railway Crossing	Gladstone Regional Council	AB474.7

Railway name	LGA	Approximate KP
CQ Salt Railway Crossing (currently disused)	Rockhampton Regional Council	AB427.6
Proposed Xstrata Balaclava Island Coal Export Terminal Project (BICET) Railway	Rockhampton Regional Council	AB445.5

Rail crossings will generally be undertaken utilising a thrust boring technique (**Figure 3-6**), micro-tunnelling or alternatively, HDD depending on geotechnical investigations and approval from QR. Traffic and safety management procedures will be implemented during construction to ensure continued safety of all involved.

3.4.1.5. Airports and airstrips

A number of airports and airstrips have been identified within 25 km of the proposed pipeline route as outlined in **Table 3-11**. Rockhampton Airport is located approximately 10.5 km to the east of the proposed pipeline route and Moranbah Airport is located approximately 24 km to the west of the proposed pipeline route.

During the construction phase of the project, workers will be employed on a fly-in fly-out (FIFO) basis and be transported via bus or private vehicle from the relevant airport to the temporary workers‘ accommodation camps. At this stage it is not possible to determine which airports and airstrips will be used by the workers as the exact location of the temporary workers‘ accommodation camps is yet to be determined.

Table 3-11: Airports and airstrips within 25 km of the proposed pipeline route

Airport / airstrip	Approximate distance from pipeline (km)
Ambrose	1.6
Annandale	2.5
Barmount	6
Batheaston	16
Bombandy Airport	8
Bombany	3
Broadmeadow	4
Byerwen	7.5
Calliope	21.5
Carfax	3
Clive	4
Coppabella	18.5
Cosmos Airport	3.5
Croydon	20

Airport / airstrip	Approximate distance from pipeline (km)
Daunia	1.5
Develin	2
Deverill	6
Dysart Aerodrome	16
Essex	22
Essex	13.5
Fort Cooper Airport	16.5
Gladstone	18.8
Goonyella	15
Iffley	6.5
Iffley Airport	4
Junee	22
Kunwarara	17.8
Lancewood	10
Landing ground	11.5
Langdale	19.8
Langley	4
Lenton Downs	5
Leura	18
Marlborough	2.2
May Downs	4
Melrose	0.8
Moranbah	24
Morpeth	23
Mount Larcom	12
Newlands	11
Ogmore	22
Ogmore	8.4
Rockhampton	10.5
Rookwood outstation	10.5
Royles	15
Royles	15
Saraji Airport	16
Suttor Creek	4.2
Tartarus	4
Vermont Airport	17

Airport / airstrip	Approximate distance from pipeline (km)
Wards Well	14
Warwick	22
Weetalaba	21
Wollombi	20

3.4.1.6. Access tracks

Equipment and personnel will require daily access to the ROW and worksites during construction. There are a number of public roads and tracks in the region and these are likely to be sufficient for construction access; however, a number of new access tracks may be needed. This will be assessed as site-specific access requirements along the proposed pipeline route are identified.

3.4.2. ENERGY

The energy requirements for the temporary workers' accommodation camps will be provided by diesel generators. Each temporary workers' accommodation camp will be equipped with three 500 kilovolt ampere (kVA) generators, one of which will be on standby at all times. The two operating generators are expected to consume about 6,000 litres of diesel per day (approx. 170 kg/hour).

Approximately 18 ML of diesel (including vehicle and equipment fuel) is expected to be used during the 15 month construction period.

3.4.3. WATER SUPPLY AND STORAGE

The *Arrow Energy Major Pipelines Water Availability Study* (**Appendix A4.9**, **Volume 3**) identifies potential water supply requirements and sources during the construction of the project. This has been summarised as follows.

Water is required for a number of aspects of the project, with the main water requirements being:

- Potable water for use within the temporary workers' accommodation camps and for personal consumption;
- Non-potable water for construction activities including dust suppression, welding, joint coating, vegetation management and weed washdown purposes; and
- Hydrostatic pressure testing water.

There are no specific water demands for the operation of the project.

Details on the estimated water requirements for the various components of the project are detailed in **Table 3-12**.

Table 3-12: Estimated water requirements for the life of the project

Construction activity	Potable water requirements	Raw water requirement
Dust suppression, mixing bentonite for HDD crossings, etc	Nil	150 ML
Temporary workers' accommodation camps	64 ML (12.8 ML/camp)	Nil
Hydrostatic testing	Nil	100 ML

3.4.3.1. Temporary workers' accommodation camp water

Water is required within the temporary workers' accommodation camps for cooking, drinking, ablutions, laundry and cleaning. This water is required to be potable. An allowance of 250 L per person per day has been allowed to provide for all required needs. Based on 400 being the maximum number of workers at each camp, the daily camp water requirement is calculated to be 200 kL. This equates to approximately 12.8 ML per temporary workers' accommodation camp over the life of the project and 64 ML of potable water in total.

Potable water for the temporary workers' accommodation camps must meet the *Australian Drinking Water Guidelines 2004* and be suitable for human consumption.

It is anticipated that five temporary workers' accommodation camps will be constructed at five different locations along the proposed pipeline route as the pipeline is constructed and each location is required to be provided with potable water. Water will be sourced from one of the following:

- Purchase water from an existing potable water service provider and transport water by a new pipeline to the camp;
- Provide a package treatment plant to treat water from a non-potable water source for camp usage; and
- Purchase water from an existing potable water service provider and transport water by vehicle to the camp.

The transportation of already treated water has been identified as the preferred approach to supplying the potable water demands as the other two options are unlikely to be cost-effective. Consideration will be given to potable water substitution and on-site treatment once the availability and ease of access to raw water supply is confirmed.

3.4.3.2. Construction site water

Non-potable water is required for construction activities including dust suppression, welding, joint coating and vehicular washdown as part of weed management. This water will be sourced from a combination of bores, turkeys' nests or dams, watercourses and piped raw water supply. In sourcing water, consideration will be given to minimising cartage distances to limit emissions, cost, travel time and environmental impact associated with vehicle movements.

3.4.3.3. Hydrostatic pressure testing water

The flushing and cleaning stage of pipeline construction involves flushing and cleaning the pipeline prior to filling it for hydrostatic testing. Hydrostatic pressure testing requires large volumes of water to be pumped into the pipe before being pressurised and includes water to flush the pipes prior to the testing. Approximately 100 ML of non-potable water will be sourced from existing supplies for hydrostatic testing over the lentire ength of the pipeline.

The nature of the use of the flush water means it can contain a range of residues and thus may require treatment prior to discharge. The flush water will be discharged to a temporary evaporation pond to concentrate any residues for disposal.

Hydrostatic pressure testing will be undertaken in test sections with approximately 25 km of pipeline being filled with water at any one time, with the opportunity to transfer water from section to section several times before it becomes unusable or limited by other factors. This will reduce the total water requirements and assist in minimising the need to transport water to the test site. There will be some loss of water during this process.

Most water requirements for the project are for hydrostatic testing purposes and will be from the following sources:

- Surface storages such as water dams and weirs;
- Municipal water supply in Gladstone and other areas;
- Water generated through CSG production in the Bowen Basin; and
- Underground bores.

Water source and disposal options will be explored to maximise efficiency of testing, timing of construction and commissioning, while considering the environmental impacts and / or benefits. Beneficial reuse of treated CSG water may also be considered at this time, if regulatory feasible.

If it is anticipated that test water may be used for 30 days or more, either by remaining in one test section or by being transferred from one section to the next, it is likely that the water will need to be treated with a combination of an oxygen scavenger and biocide to prevent corrosion attributable to oxygen or microbial / bacterial action.

3.4.3.4. Potential water sources

Potable water will be sourced from local reticulated water supplies where available. A review of existing potable water supplies in the vicinity of each proposed temporary workers‘accommodation camp location is summarised in **Table 3-13**.

Table 3-13: Temporary workers' accommodation camps – potable water supply assessment

Temporary workers' accommodation camp number and location	LGA	KP	Nearest town with water supply	Distance to potable water supply (km)
5 (Red Hill)	Isaac Regional Council	AB57	Moranbah is south of the camp	28
4 (Daunia)	Isaac Regional Council	AB100	Moranbah is west of the camp	35
3 (Hillcrest)	Isaac Regional Council	AB215	Middlemount is southwest of the camp	48
2 (Foresthome)	Rockhampton Regional Council	AB324	Marlborough is south of the camp, however this only has a small non-potable water supply. Potable water supply from Rockhampton is required.	75
1 (Bajool)	Rockhampton Regional Council	AB424	Bouldercombe is west of the camp, however the town only has a small population of 1,300 and no reticulated water supply. Rockhampton is approximately 28 km north north-west of the camp, with potable water supply required from here.	28

Isaac Regional Council

Temporary workers‘ accommodation camp 3 (Hillcrest), camp 4 (Red Hill) and camp 5 (Daunia) are proposed to be located in the Isaac Regional Council LGA.

For camp 4 and 5, potable water supply will be required to be trucked from the township of Moranbah. Moranbah has a population of approximately 8,000 people who service a number of mines in the region. It is noted that the Urban Land Development Authority (ULDA) has identified a large development area southwest of the existing town to meet future expansion of the local mining operations.

For camp 3, potable water supply will be required to be trucked from Middlemount. Middlemount is located approximately 242 km southwest of Mackay and has a population of approximately 2,000 which services local mining operations at the German Creek and Foxleigh coal mines.

Isaac Regional Council currently provides occasional potable water supply for a range of demands throughout Central Queensland, with approximately 100 ML/annum supplied via a number of standpipe locations throughout council's water supply network.

Preliminary discussions with Isaac Regional Council indicated there are existing standpipes in both Middlemount and Moranbah that would be capable of providing 200 kL/day to meet potable water demand at the proposed temporary workers' accommodation camp locations. The current water price supplied from the standpipe locations is $10.50/kL (GHD, 2011).

Rockhampton Regional Council

Temporary workers' accommodation camps 1 (Bajool) and 2 (Foresthorne) are proposed to be located in the Rockhampton Regional Council LGA. Given the camp locations along the proposed pipeline route, potable water supply will need to be trucked into each camp from the Fitzroy River Water Scheme servicing Rockhampton. This supply is located approximately 30 km north and 75 km southeast of camp 1 and camp 2 respectively.

Given the considerable distance between camp 2 and the identified potable water supply source and the site's proximity to the Fitzroy River, the possibility of substituting part of the camp water supply with non-potable supply at this location is identified as a potential opportunity. It is noted that the duration of camp operation is relatively short, being eight to ten weeks. Given the additional effort to manage dual reticulation infrastructure with a mixed potable and non-potable supply and obtaining a raw water allocation at this location, this option was not considered to be a viable alternative compared to the transport of potable water supply to this location.

Preliminary discussions between Arrow and Fitzroy River Water identified that short term potable water supply is available for purchase through the hire of access to a standpipe. Water can be drawn from fire hydrants at a number of locations throughout the network to meet the temporary workers' accommodation camp supply demands (200 kL/day). Provision for multiple standpipes may facilitate more efficient delivery to the camp locations.

Gladstone Regional Council

Gladstone municipal water supply under the jurisdiction of Gladstone Regional Council is the primary water supply for Gladstone Area Water Board (GAWB) and may be utilised by the project.

Alternative temporary workers' accommodation camp locations

The location of temporary workers' accommodation camps within existing townships has been avoided to minimise negative socio-economic impacts to these communities. However, from a potable water supply perspective, there are a number of towns that may have an existing potable water supply capacity to satisfy the requirements of these camps. These include the townships of:

- Glenden;
- Moranbah;
- Middlemount; and
- Rockhampton.

With the exception of Rockhampton, the existing towns of Glenden, Moranbah and Middlemount predominantly service local mining operations.

Temporary workers' accommodation camp requirements

Potable water trucked into the temporary workers' accommodation camps will be discharged into storage tanks. The reticulated potable water supply network within each camp will be supplied from the storage tank via a booster pump arrangement providing adequate flow and pressure to the network. It is possible that reserve capacity in the storage tank and a hydrant booster pump may be required for emergency fire supply provision. This assessment will be completed as part of building services.

Depending on temporary workers' accommodation camp utilisation, demountable facilities and temporary water supply infrastructure will be able to be re-located and re-established at a number of temporary workers' accommodation camp locations as construction progresses. These temporary workers' accommodation camps are to be fully self-contained with an on-site wastewater treatment facility and disposal system identified as part of waste management requirements.

Non-potable water supply

As identified above, non-potable water supply for construction activities includes allowances for dust suppression, weed management, vehicle wash-down and hydrostatic pressure testing of the proposed pipeline. The following sections outline the likely supply and delivery configuration requirements associated with the broad construction water demand categories.

Construction activities

A total non-potable water allowance of 150 ML has been identified for construction activities for the project. Construction activities will include dust suppression, welding, joint coating, with potential ancillary uses associated with pipe backfill and vehicular wash-down as part of weed management.

Water supply for construction activities will be provided directly from water trucks, with trucks filled from non-potable raw water sources along the proposed pipeline route including bores, dams, watercourses and piped raw water supplies.

No provision of storage along the proposed pipeline route has been identified for this water, and it will be sourced and used on an ~~-as~~ needs" basis.

Hydrostatic pressure testing

Hydrostatic pressure testing will be completed prior to commissioning the proposed pipeline to verify the pipe is completely sealed and confirm its ability to operate at the MAOP. Approximately100 ML of non-potable water will be sourced from existing supplies to meet testing requirements over the entire length of the pipeline.

Non-potable water resource locations

SunWater infrastructure and water resources

SunWater operates a number of water supply schemes providing water to mines, towns and rural consumers throughout Central Queensland. Preliminary discussions were held with SunWater to discuss potential availability of short term allocations to meet the construction pipeline non-potable water requirements.

Discussions with SunWater were based on the following non-potable supply demands for the project construction phase:

- Construction activities are planned to start in April 2016 and be completed in July 2017; and
- Total water need is in the order of 250ML, comprising:
  - 150ML for construction; and
  - 100ML for hydrostatic testing.

The proposed pipeline route was reviewed with respect to existing and planned SunWater or dedicated pipelines. Sections of the pipeline relative to SunWater-owned and operated pipelines or regulated streams are identified in **Table 3-14**.

Table 3-14: Water sources for the project

Water pipeline	Description	Proximity to the project	Potential length and KP to be serviced	Potentialwater demand
Newlands Pipeline	Existing pipeline with a single client being serviced, also supplies the township of Glenden. Water source is the Bowen River Weir and Gattonvale Offstream Storage.	Crosses the AB mainline at AB12.	60 km; AB0 – AB60	19ML (construction) + 50ML (hydrotesting)
Burdekin Moranbah Pipeline (BMP)	Existing pipeline, runs parallel to the Eungella Pipeline for a section, supplies the Moranbah township and surrounding mine sites. Sourced from the Burdekin Falls Dam.	Crosses AB mainline at AB27. Runs parallel within 2 km of the route between AB24 and AB37. Within 15 km of route between AB37 and AB68.	75 km; AB0 – AB75	24ML + 50ML
Eungella Water Pipeline	Existing pipeline, runs parallel to the BMP for a section, supplies the Moranbah township and surrounding mine sites. Sourced from the Eungella Dam.	Crosses the AB mainline at AB27. Runs parallel within 2 km of the route between AB24 and AB37. Within 15 km of the AB mainline between AB37 and AB68.	75 km; AB0 – AB75	24ML + 50ML
Eungella Water Pipeline Eastern Spur Pipeline	Existing pipeline, delivery from Moranbah to Coppabella. Sourced from the Eungella Dam.	Within 15 km of the AB mainline between AB68 and AB90. Runs parallel to route between AB90 and AB95.	85 km; AB45 – AB130	27ML + 50ML
Eungella Pipeline Southern Spur Pipeline	Existing pipeline, delivery from Moranbah to mine sites north of Dysart. Sourced from the Eungella Dam.	Largely runs parallel 40 km west of the AB mainline between AB95 and AB160.	65 km; AB95 – AB160	20ML
Eungella Pipeline Southern Spur Pipeline Duplication	Proposed duplication of the Southern Spur from Moranbah to Saraji. Sourced from the Eungella Dam.	Largely runs parallel 40 km west of the AB mainline between AB95 and AB160.	65 km; AB95 – AB160	20ML

Water pipeline	Description	Proximity to the project	Potential length and KP to be serviced	Potentialwater demand
Connors River to Moranbah Pipeline	Proposed pipeline currently planned for construction in 2015 (and therefore may be operational when the project is being constructed). Sourced from the Connors River Dam.	Follows the Eungella Pipeline Southern Spur Pipeline route in the vicinity of the AB mainline, running parallel to route between AB90 and AB95.	85 km; AB45 – AB130	27ML + 50ML
Saraji Pipeline	Existing pipeline transferring water from the Nogoa Mackenzie Water Supply Scheme to Norwich Park, Saraji, Peak Downs and German Creek mines, and towns including Dysart and Middlemount.	This pipeline and lateral connections are within 40 km of the AB mainline between AB170 and AB250.	120 km; AB130 – AB250	38ML
Middlemount Pipeline	Proposed pipeline from Bingegang Weir to Middlemount, currently under investigation.	Middlemount is the closest point to the AB mainline and is approximately 30 km south of the AB mainline at around AB200.	30 km; AB185 – AB215	9ML
Stanwell Pipeline	Existing pipeline from the Lower Fitzroy Water Supply Scheme to the Stanwell Power Station.	Crosses the AB mainline at AB387. Within 15 km of the AB mainline between AB370 and AB400.	70 km; AB350 – AB420	22ML + 50ML

Additional raw water sources

The project can be serviced to a large extent via SunWater-controlled infrastructure. However, other non-potable water sources may provide a better servicing outcome for the construction demands due to proximity, cost or phasing. A review of these water sources is included in **Table 3-15** and correspond to the potential water requirement based on the source‘s proximity to the construction zone limited to a nominal maximum transportation distance of 50 km. Alternative sources may overlap and the best solution will need to be determined based on issues such as cost, available capacity, ability to garner an allocation agreement and access to the resource.

Table 3-15: Raw water sources and potential service requirements

Raw water pipeline	Description	Proximity to the project	Potential length and chainage to be serviced	Potential not potable water demand
Isaac River	The Isaac River and tributaries are part of the Fitzroy Basin. Groundwater or river extraction is licensed by DERM. Water resource to be obtained from existing allocation holders via the water market.	The Isaac River is crossed by the AB mainline at AB50, AB165 and AB235, and generally flows parallel to the AB mainline.	200 km; AB50 – AB250	63ML + 50ML
Nogoa Mackenzie Water Supply Scheme	The Nogoa Mackenzie Water Supply Scheme predominantly services agricultural and mining water requirements around Emerald and along the Mackenzie River. SunWater manages this water supply scheme as a regulated supply and is able to trade its allocations via the water market.	The Tartarus Weir is just 2 km from the AB mainline at AB260, with this location within 30 km of the AB mainline route between AB250 and AB275.	45 km; AB240 – AB285	14ML + 50ML
Lower Fitzroy Water Supply Scheme	The Lower Fitzroy Water Supply Scheme extends from the Fitzroy Barrage to the Eden Bann Weir. The scheme primarily services the Stanwell Power Station as well as agricultural and riparian allocation holders along the Fitzroy River. SunWater manages this reach of the Fitzroy River as a regulated supply and is able to trade its allocations via the water market.	The AB mainline crosses the Fitzroy River at the Fitzroy Barrage which corresponds to the upper extent of SunWater's scheme. This is located at AB320, with the AB mainline within 10 km of the scheme extents between AB310 and AB350.	100 km; AB280 – AB380	31ML + 50ML
Fitzroy River	The Fitzroy River and tributaries are part of the Fitzroy Basin. River and groundwater extraction is licenced by DERM, and water may be able to be obtained from existing allocation holders via the water market. Alternatively, customers could be approached directly. Downstream reaches of the Fitzroy River may potentially be brackish or saline.	The Fitzroy River flows predominantly parallel to the AB mainline from AB370 to AB415, and is within 20 km of the AB mainline.	85 km; AB350 – AB435	27ML

Raw water pipeline	Description	Proximity to the project	Potential length and chainage to be serviced	Potential not potable water demand
Raglan Creek	Raglan Creek is a creek approximately 20km northwest of Mount Larcom and flows north to the Coral Sea. Waterway and groundwater extraction is licenced by DERM, and water may be able to be obtained from existing allocation holders via the water market. Downstream reaches of Raglan Creek will be saline.	The AB mainline crosses Raglan Creek at AB445.	50 km; AB420 – AB470	16ML + 50ML

3.4.4. STORMWATER DRAINAGE

The specific use of stormwater diversion drains during construction and the final landform following completion of rehabilitation of the ROW is discussed in **Section 4.5** and in the EMP (**Chapter 5**). Temporary stormwater drains are located at waterway crossings and in areas of high slope to divert stormwater away from the ROW. Permanent stormwater drains are located as per the EMP.

Temporary workers' accommodation camps and maintenance areas will not be established in areas known to be prone to flooding. Rainfall will be directed away from chemical storage areas and pumped to a holding facility for ultimate treatment and/or disposal.

3.4.5. SEWERAGE

Facilities at temporary workers' accommodation camps will include an approved self-contained packaged sewage treatment plant (STP). Approval for sewage treatment plants will be sought separate to the EIS from DERM under the IDAS pursuant to the SP Act. Each treatment plant will be capable of handling sewerage and other wastewater generated with a capacity greater than the maximum camp capacity (400 people) expected within one temporary workers' accommodation camp. The contractor supplying the treatment plants will be required to produce treated effluent of a quality suitable for disposal to land.

3.4.6. TELECOMMUNICATIONS

The provision of temporary telecommunication systems will be required during the construction stage of the project. This will include fixed station satellite dishes at the temporary workers' accommodation camps and the installation of radios (UHF or VHF) in the construction vehicles to enable communication between vehicles.

The radio network will require installation of portable temporary repeater towers at intervals along the pipeline. The selection of the tower sites will be determined by the extent of the transmission required, and the physical characteristics of the site. Environmentally or culturally significant locations will be avoided.

The repeater towers will be guyed towers (**Plate 3-52**) located where possible on elevated ground to improve transmission range. They will be powered by solar panels. At the completion of construction, the temporary towers will be removed and site reinstatement works undertaken.

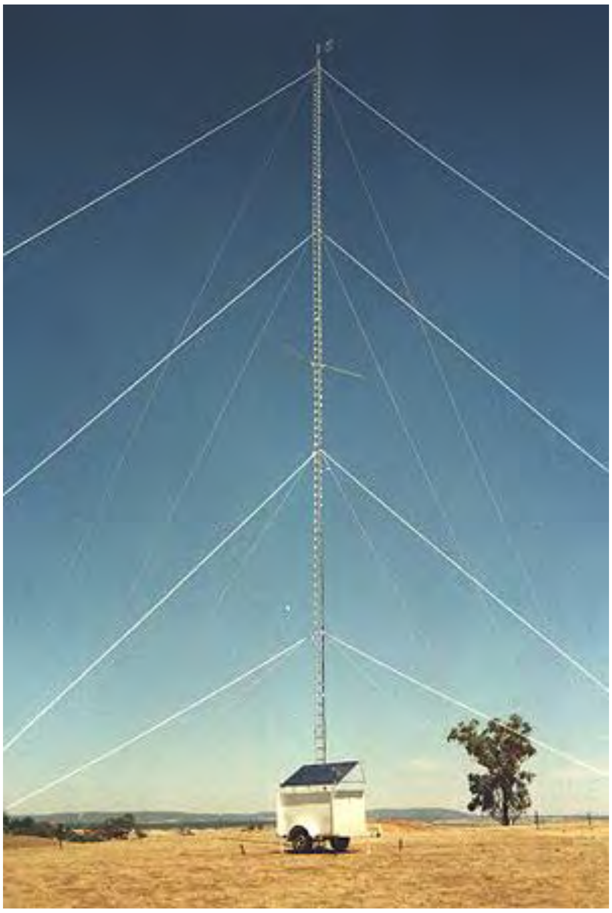


Plate 3-52: Communication trailer and mast

3.4.7. OTHER INFRASTRUCTURE

No additional infrastructure is required by the project.

3.5. WASTE MANAGEMENT

The EP Act, *Environmental Protection Regulation 2008* (EP Regulation), *Environmental Protection (Waste Management) Regulation 2000* and EPP (Waste), govern waste management associated with the development, operation and decommissioning of the pipeline.

Relatively small amounts of domestic and industrial waste will be generated during construction, operation and decommissioning of the pipeline. Waste management will be based on waste avoidance, minimisation and recycling before disposal. A licensed waste disposal contractor will be engaged to remove and dispose of all wastes from the construction site and temporary workers‘ accommodation camps. A list of typical wastes to be generated by the project during the construction, operational and decommissioning phases of the project is provided in **Table 3-16**.

Table 3-16: Typical wastes from the project

Construction wastes	Operational wastes	Decommissioning wastes
▪ Road base / topping (for open-cut crossings). ▪ Packaging (ropes, cardboard), fibre / nylon rope spacers, drums and scrap metals. ▪ Used oils e.g. lube oil, used tins from coating paint. ▪ Scrap – welding rods (stub ends) / grinding discs. ▪ HDD cuttings / tailings (bentonite). ▪ Hydrostatic test water. ▪ Camp site wastes – putrescibles, paper, timber and plastic piping. ▪ Camp site waste water. ▪ office waste - cardboard, paper, prining consumables, etc.	▪ Sludge (pigging). ▪ Packaging.	▪ Scrap metal.

Expected total volumes of each waste produced and disposal options are provided in **Section 4.4.1**.

Schematic diagrams describing waste for each distinct stage of the project and have not been provided as they are not relevant for a non process related project.

3.5.1. AIR EMISSIONS

Atmospheric dust, principally from clearing and grading, trenching, backfill and reinstatement and vehicle movements, will be the main cause of air emissions during the construction phase of the project. The impacts of dust generation will be short term and generally localised as the construction team works through an area.

Dust suppression measures will include water trucks.

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, local traffic and transport land uses in the project area. No measurable impact is likely. This is assessed further in **Section 4.6**.

Some small quantities of gas will be released into the atmosphere during commissioning activities which will involve purging the pipeline of air with CSG.

The anticipated gas composition is 98.47% methane, 0.2% carbon dioxide and 1.33% of nitrogen. A slug of nitrogen will be placed between the air and the gas to prevent direct mixing of these two components in the pipeline for safety reasons.

Fugitive emissions from pipeline operations are extremely low. Valves will be operated to ensure their availability in the event of an emergency. Extremely small volumes of gas may be released during this activity as the valves are likely to be powered by the pressure in the pipeline. There are no scheduled releases of gas other than extremely small quantities associated with pipeline pigging activities that occur once every five years and other very limited releases during certain routine operational activities (e.g. valve testing). Pigging may occur at more frequent intervals in the unlikely event of pressure/temperature/flow data indicating that the pipeline needs cleaning to improve its efficiency.

The risk of pipeline ruptures or leaks is also extremely low due safety factors utilised during design and to the implementation of preventative measures and routine monitoring, inspection and maintenance.

A breakdown of the quantity of all air emissions from the project during construction and operation is provided in **Table 3-17**.

Table 3-17: Breakdown of air emissions from the project (construction and operation)

Air emission	Construction		Operation	
	Quantity	Source	Quantity	Source
Fugitive emissions of CSG	28,667 t CO_2-e	Diesel generators, construction equipment, light vehicles	5,232 t CO_2-e	Operation of a 600 km long natural gas transmission pipeline

Detailed information on the air emissions produced from the project, including a qualitative assessment is provided in **Section 4.6**.

3.5.1.1. Greenhouse gas emissions

During pipeline construction, greenhouse gases will be emitted by vehicles and machinery and equipment. Greenhouse gases emitted during pipeline operations will predominantly arise from the very small quantities of gas (primarily methane) released during routine maintenance.

The quantity of greenhouse gases emitted during all these activities will be very small and will have immeasurable environmental or health impacts. Details are provided in **Section 4.6**.

3.5.2. EXCAVATED WASTE

There will be very little excavated waste during construction of the pipeline. All suitable material extracted during trenching will be re-used in the trench either as padding of backfill for the pipeline (**Section 4.4**). Subsoil and topsoil will be reused during rehabilitation of the ROW.

Used bentonite slurry from HDD operations will be decanted to remove drill cuttings and recycled as part of the HDD operation. The tailings discharged during HDD will be used as padding or buried in the pipeline trench or a pit in the ROW. This waste will consist of inert clay (bentonite), subsoil and granulated rock. Rock produced by blasting may be removed from the construction site if not wanted by landholders for farm use. Any materials considered to be contaminated will be isolated and removed to a licensed landfill by a licensed contractor.

No additives will be introduced in the excavation process.

3.5.3. SOLID WASTES

Other wastes likely to be produced during pipeline construction include:

- General waste from temporary workers' accommodation camp sites and site offices that will be collected, sorted for recyclables (such as paper, glass, etc) and the remainder disposed of to landfill;
- Cleared vegetation, which may be re-spread as windows or chipped and re-spread along the ROW;
- Workshop wastes such as empty paint cans and grease/oils will be disposal by a licensed contractor at an approved regulated waste disposal/recycling facility; and
- Skids that will be reused as often as practicable and then recycled.

Scrap metal generated as a result of decommissioning will be recycles if practical or removed from site by a licensed waste disposal contractor. Such solid wastes are discussed in **Section 4.4**.

3.5.4. LIQUID WASTES

Generation and treatment of wastewater associated with the temporary workers‘ accommodation camps is described in **Section 4.4**. Most of the daily water consumption of 200 KL will be discharged as treated waste from the kitchen, laundry and ablution facilities.

The volume of water used to hydrostatically pressure test the pipeline has been calculated as up to 25 ML per 25 km test section based on the criteria presented in **Section 3.2.3.10**. Approximately 1 ML of this water will be discharged at the end of each test section (approximately every 25 km) after use as a first flush ‗slug‘. The total volume of hydrotest water over the length of the proposed pipeline route has been estimated to be 100 ML. The water will be piped into a lined temporary evaporation pond and any residues removed with other industrial waste.

It is not anticipated that groundwater will be intercepted during construction of the proposed pipeline.

Any water encountered during deep excavations will be disposed of by pumping to adjacent land through a suitable filtering medium and in such a way that erosion is not caused.

Waste oils, lubricants and other similar substances will be recycled where possible or otherwise removed by a licensed waste disposal contractor and disposed of at an approved regulated waste disposal/recycling facility.

Liquid waste chemicals, such as solvents, will be disposed of by a contractor to a suitably regulated waste facility.

3.5.4.1. Disposal of hydrostatic testing water

The hydrostatic water comprises flush water and the testing water, both of which require disposal. The method of disposal of the testing water will depend on the quality of the water, and may include:

- Discharge to farm dams;
- Holding ponds for reuse by other industry;
- Reuse in another test section; and
- Land disposal.

Prior to the discharge into the environment, test water quality will be assessed, and the water then discharged to an appropriate point of discharge depending on the water quality. If levels of potential contaminants are found to be above the required water quality parameters the following options may be adopted:

- Oxygen scavengers and biocides (proven to biodegrade on aeration) will be added;

- The water will be held in an approved holding area and allowed to evaporate off with any residues collected for disposal; or
- Chemicals or other agents will be added to neutralise the environmental effects of the contaminants.

Hydrostatic test waters will not be directly discharged to natural waterways.

Erosion may arise if the hydrostatic test water is discharged onto land under pressure. Consequently some form of energy dissipation, which will also act as an aerator, will be employed prior to the water coming into contact with the surrounding land. Prior to discharge, hydrostatic test waters will be filtered through a geotextile fabric or retained in a temporary sediment retention basin to remove the majority of any solid materials.

Hydrostatic test water that does not meet required water quality standards for direct disposal will not be discharged directly to the environment. Further details on hydrostatic testing are contained in **Section 3.2.3.10**.

3.6. REHABILITATION AND DECOMMISSIONING

3.6.1. REHABILITATION

Clean up, restoration and rehabilitation measures will be undertaken in all areas disturbed during construction, including the ROW, access tracks and temporary workers' accommodation camp sites, as soon as practical after pipe laying and backfill. Generally, clean up (illustrated in **Plate 3-53**) and rehabilitation will involve removal of foreign material (construction material and waste), surface contouring, respreading topsoil, respreading vegetation and reseeding / revegetation (typically via natural regeneration or seeding of native grass or matching improved pasture species).

Plate 3-53: Clean up of ROW

Generally, the landscape will be rehabilitated to pre-existing contours with natural drainage lines restored and protected (if required). In certain cases, rehabilitation will be tailored to site-specific conditions in consultation with the landholder. To promote vegetation regrowth and protect against the loss of topsoil, the ROW surface will normally be lightly scarified prior to respreading of topsoil.

Rehabilitation (illustrated in **Plate 3-54** to **Plate 3-55**) will be undertaken in accordance with best practice and will ensure that:

- Topsoil cover is re-established and all land and waterways disturbed by project activities are returned to a stable condition as soon as practicable after construction;
- Land is returned as close as possible to its previous productivity;
- Stable landforms are re-established to original topographic contours;
- Natural drainage patterns are reinstated;
- Erosion control measures (e.g. contour banks, filter strips) are installed in erosion-prone areas;
- The pre-construction environment is reinstated and disturbed habitats recreated;
- Fences and gates are restored; and
- Pipeline marker signs are installed.

Plate 3-54: Rehabilitation of ROW across a road

Plate 3-55: Rehabilitated ROW in rural area

Plate 3-56: Rehabilitated ROW in rural area

Plate 3-57: Rehabilitated ROW in rural / wooded area

3.6.2. DECOMMISSIONING

When, and if, the proposed pipeline is no longer required, it will be decommissioned in accordance with the regulatory requirements and accepted environmental best practices at that time. Currently, decommissioning procedures require the removal of all above ground infrastructure (including all scraper station plant and all pipeline valves and metering stations) 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. The following two options will be considered:

- Moth-balling – this would involve depressurising the pipeline, capping and filling with an inert gas (such as nitrogen) or water with corrosion inhibiting chemicals. The cathodic protection would be maintained to prevent the pipe corroding; and
- Abandonment – this could involve purging the pipe of natural gas, disconnecting it from the manifolds and removing all above ground facilities. The pipe would then be filled with water and left to corrode in-situ. Removing the pipe from the ground is unlikely to be an environmentally- or commercially-viable option. A detailed rehabilitation program would be developed and implemented in consultation with landholders and the regulatory agencies at the time of abandonment.

4. ENVIRONMENTAL VALUES AND MANAGEMENT OF IMPACTS

This chapter of the EIS considers the environmental values, impacts and mitigation measures associated with the construction, operation and decommissioning stages of the project. Where applicable, cumulative impacts are also assessed and environmental protection objectives for enhancing or protecting each environmental value is described.

The environmental values considered include:

- Climate;
- Land;
- Transport;
- Waste;
- Water;
- Air;
- Noise and vibration;
- Ecology;
- Cultural heritage;
- Social values;
- Health and safety;
- Economy; and
- Hazard and risk.

4.1. CLIMATE

This section of the EIS describes the climatic factors that may impact on the project. Meteorological data from the Bureau of Meteorology (BOM) has been reviewed to describe the existing meteorological and climatic influences in the project area.

Legislation, policies and guidelines

The assessment of climate associated with the project is based on applicable legislation, policies and guidelines as outlined in **Table 4-1**.

Table 4-1: Legislation, policies and guidelines for climate

Legislation, policies and guidelines	Relevance
ClimateQ: toward a greener Queensland	▪ Forms Queensland's response to the challenge of climate change. It presents investments and policies to ensure Queensland remains at the forefront of the national climate change response. Refer to **Section 1.5.2.8**.
National Climate Change Adaption Framework	▪ Supports decision-makers with practical guides and tools to assist in managing climate change impacts. ▪ Establishes a new centre for climate change adaption to provide decision makers with robust and relevant information on climate change impacts, vulnerability and adaption options. ▪ Provides climate change projections and regional scenarios at scales relevant to decision makers. ▪ Generates the knowledge to understand and manage climate change risks to water resources, biodiversity, coasts, agriculture, fisheries, forestry, human health, tourism, settlements and infrastructure. ▪ Works with stakeholders in key sectors to commence developing practical strategies to manage the risks of climate change impacts. ▪ Assesses the implications of climate change and possible adaptations for important regions. Refer to **Section 1.5.2.8**.
State Planning Policies (SPP)	▪ SPP 1/03 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* requires likely impacts of climate change on natural hazards to be incorporated into hazard assessment studies. Refer to **Section 1.5.2.4**

Relevant national and international standards

Major standards that will apply to the project for climate include:

- *AS/NZS 1170.2:2011 Structural Design Actions – Part 2: Wind Actions;*
- *AS 1170.4:2007 Structural Design Actions – Part 4: Earthquake Actions in Australia; and*
- *AS 3959-2009 Construction of buildings in bushfire-prone areas.*

Methodology

The Moranbah Water Treatment Plant and Rockhampton Aero BOM monitoring stations were chosen as being representative of meteorological conditions in the project area. Details of the monitoring stations are provided in **Table 4-2**.

Table 4-2: Bureau of Meteorology monitoring stations

Monitoring station	Latitude / Longitude	Elevation	Availability of data
Moranbah Water Treatment Plant (station number: 034038)	21.99 °S 148.03 °E	260 m	1972 onwards
Rockhampton Aero (station number: 039083)	23.38 °S 150.48 °E	10 m	1939 onwards

Source: BOM, 2011

4.1.1. DESCRIPTION OF ENVIRONMENTAL VALUES

The project area is predominantly sub-tropical, with temperatures varying from warm to hot in summer, to mild to cool in winter with large daily variations. Rainfall averages indicate a distinct wet and dry season, with the wet period generally between December to March and a dry period between June and September. The climate in the project area is greatly influenced by the trade wind belt.

A summary of the temperature, humidity and rainfall data for the Moranbah meteorological station is presented in **Table 4-3**.

Table 4-3: Climatic summary for Moranbah (BOM site 034038)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean daily maximum temperature (°C)	33.9	33.1	32.2	29.6	26.6	23.8	23.8	25.5	29.3	32.3	33.1	34.0	29.8
Mean daily minimum temperature (°C)	21.9	21.8	20.2	17.6	14.4	11.2	9.9	11.1	14.2	17.6	19.4	21.1	16.7
Mean 9am air temp (°C)	26.4	25.8	24.7	22.1	18.9	15.4	14.7	16.6	20.6	24.0	25.3	26.4	21.7
Mean 9am relative humidity (%)	69	74	70	72	73	73	69	66	60	58	60	64	67
Mean 3pm air temp (°C)	32.7	31.9	31.2	28.6	25.8	22.9	22.9	24.6	28.3	31.4	32.2	33.0	28.8
Mean 3pm relative humidity (%)	43	48	41	43	43	44	39	35	30	31	34	38	39
Mean rainfall (mm)	103.7	100.2	50.6	36.4	34.5	22.1	18.0	23.8	9.3	36.3	70.4	101.4	603.5
Mean no. of rain days	8.3	8.1	5.3	4.3	3.8	3.2	2.6	2.1	2.2	3.9	6.3	7.2	57.3

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean no. of clear days	5.1	3.8	7.4	9.9	10.9	13.4	16.4	16.8	16.7	14.2	10.2	7.3	132.1
Mean no. of cloudy days	10.4	11.0	8.6	7.2	7.7	6.6	4.8	4.1	2.8	4.7	6.6	8.3	82.8

Source: BOM, 2011

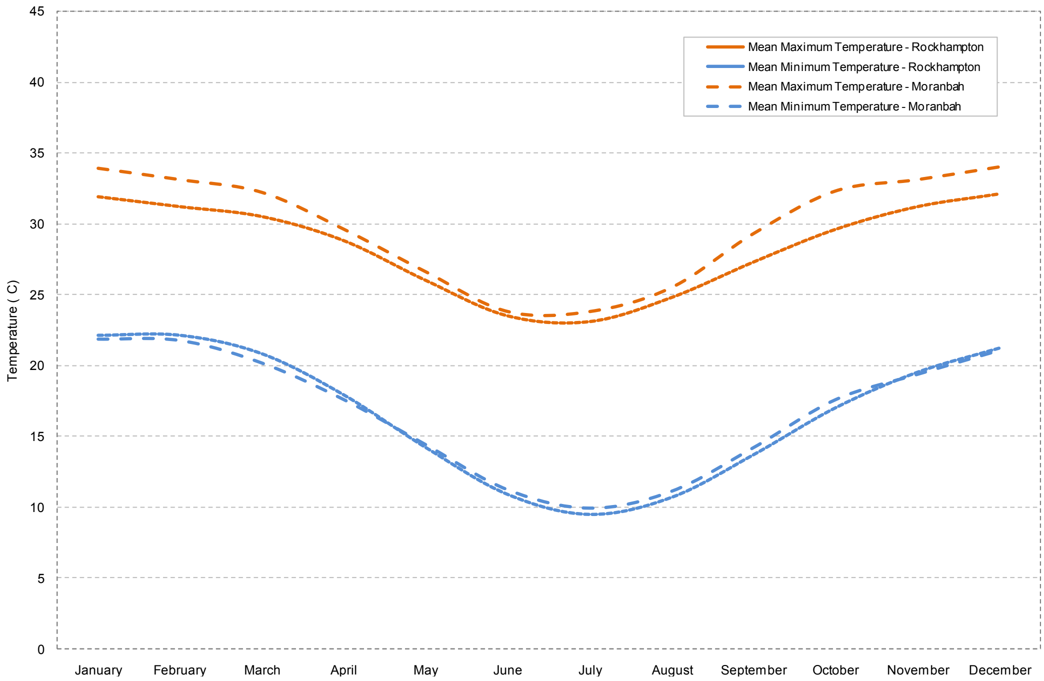
A summary of the temperature, humidity and rainfall data for the Rockhampton Aero meteorological station between 1939 and 2011 is presented in **Table 4-4**.

Table 4-4: Climatic summary for Rockhampton (BOM site 039083)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean daily maximum temperature (°C)	31.9	31.2	30.5	28.8	26.0	23.5	23.1	24.8	27.3	29.6	31.2	32.1	28.3
Mean daily minimum temperature (°C)	22.1	22.1	20.8	17.9	14.2	10.9	9.5	10.7	13.7	17.0	19.5	21.2	16.6
Mean 9am air temp (°C)	26.8	26.3	25.3	23.0	19.6	16.3	15.4	17.2	20.7	23.8	25.8	26.8	22.2
Mean 9am relative humidity (%)	70	73	72	71	71	72	72	68	65	62	62	66	69
Mean 3pm air temp (°C)	30.6	29.9	29.4	27.7	25.0	22.7	22.3	23.8	26.2	28.3	29.8	30.7	27.2
Mean 3pm relative humidity (%)	53	57	54	49	47	46	42	40	40	42	46	49	47
Mean rainfall (mm)	126.5	143.5	99.2	43.8	46.8	38.1	28.7	27.8	24.5	49.6	69.9	108.6	805.4
Mean no. of rain days	11.2	12.3	10.1	6.6	6.2	4.9	5.1	4.3	4.1	6.5	7.9	9.7	88.9
Mean no. of clear days	3.5	2.4	6.2	9.7	11.1	13.8	15.6	16.3	14.8	10.7	7.1	5.1	116.3
Mean no. of cloudy days	13.0	13.2	10.9	7.9	8.6	7.2	6.3	5.1	4.1	6.3	8.0	10.1	100.7

Source: BOM, 2011

Average monthly maximum and minimum temperatures at Moranbah and Rockhampton meteorological stations are presented in **Figure 4-1** and show the seasonal variations across the project area.

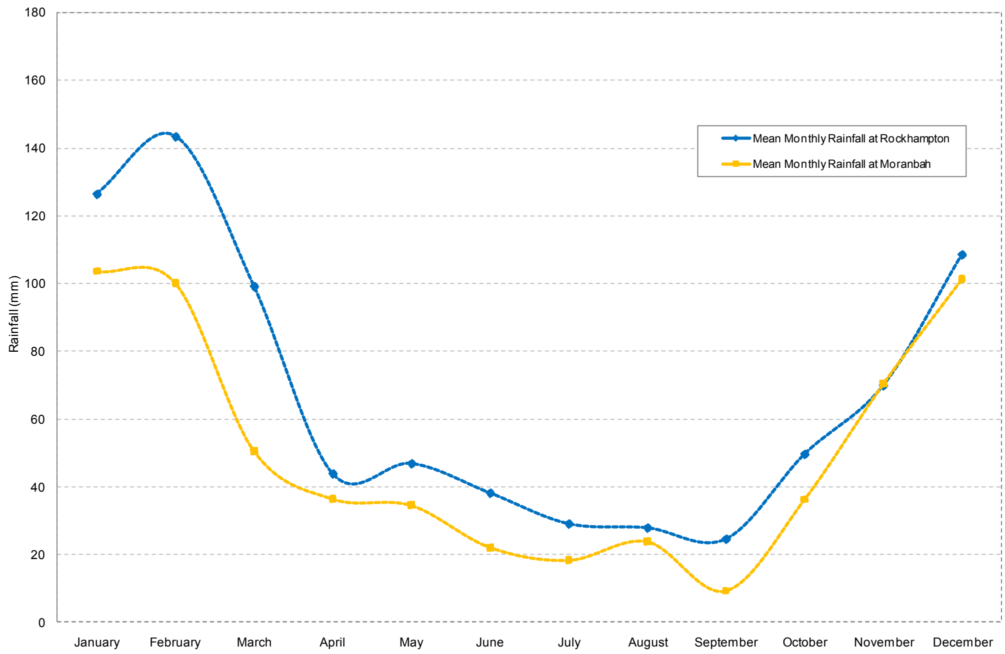


Source: BOM, 2011

Figure 4-1: Average monthly temperature data recorded at Moranbah and Rockhampton

As shown in **Figure 4-1**, mean summer maximum temperatures measured at Rockhampton Aero meteorological station are generally lower than those recorded at the Moranbah Water station to the north. Mean minimum temperatures recorded are similar at each station.

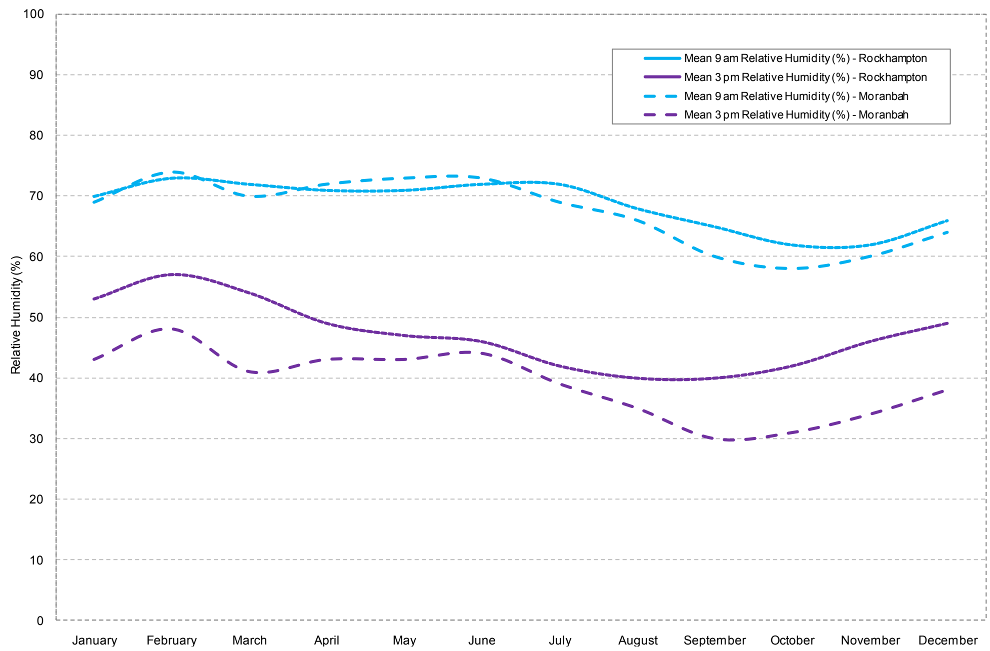
The seasonal variation in average rainfall data collected at the Moranbah and Rockhampton meteorological stations is shown in **Figure 4-2**. The average annual rainfall is 603.5 mm at Moranbah and 805.4 mm at Rockhampton. In general, higher rainfall is experienced in areas close to the coast. January and February are the wettest months. September is the driest month in these locations with mean rainfall of 24.5 mm and 9.3 mm at Rockhampton and Moranbah respectively.



Source: BOM, 2011

Figure 4-2: Average rainfall data recorded at Moranbah and Rockhampton

A seasonal comparison of relative humidity (%) at the Moranbah and Rockhampton meteorological stations for the morning (9 am) and afternoon (3 pm) periods is provided in **Figure 4-3**. The relative humidity is higher in the morning than the afternoon.



Source: BOM, 2011

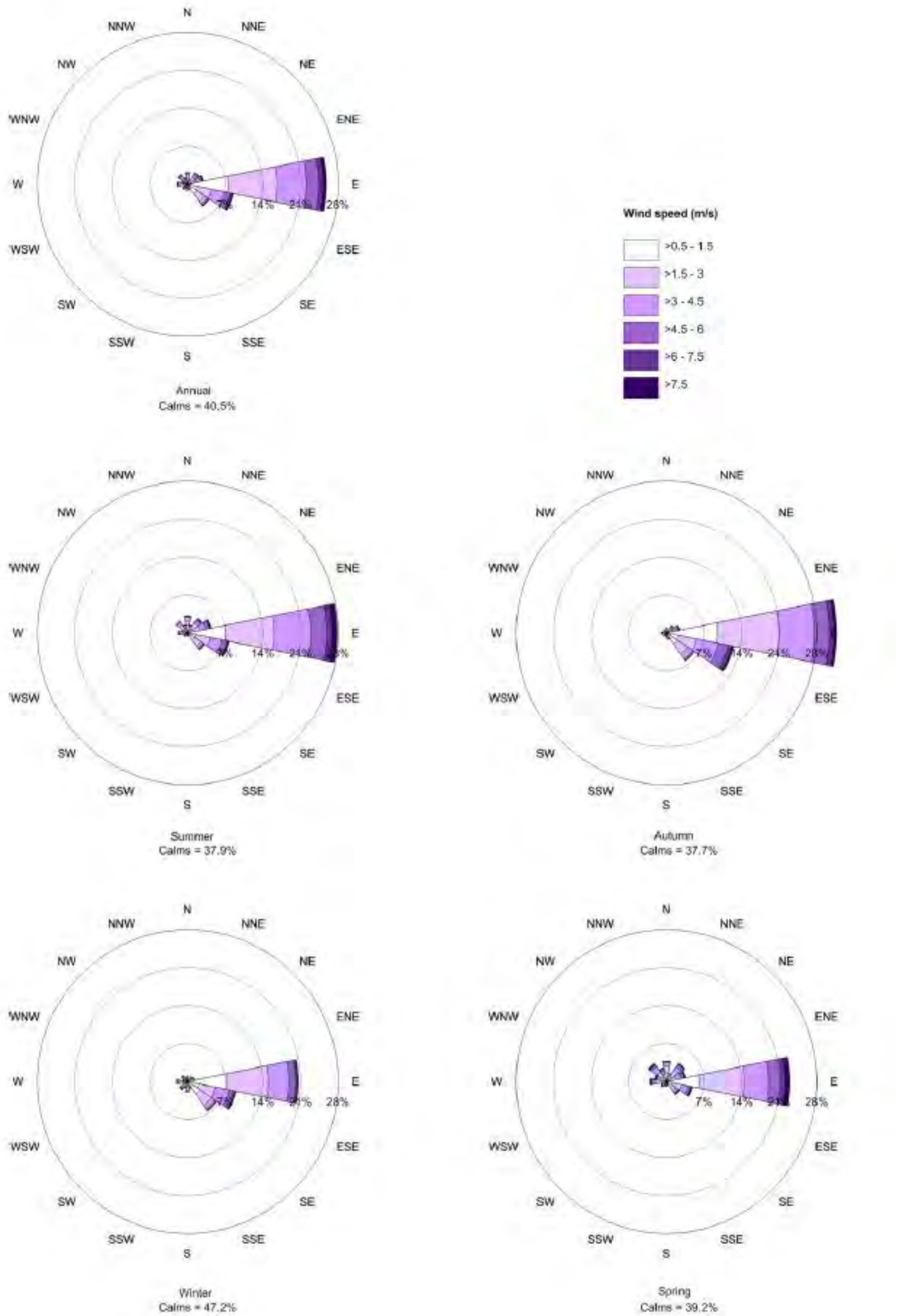
Figure 4-3: Mean relative humidity data recorded at Moranbah and Rockhampton meteorological stations

The prevailing wind patterns, as recorded by BOM at Moranbah from 1986 to 2005, are presented in **Figure 4-4**. The general features of the wind environment at Moranbah are:

- Winds are predominantly easterlies; and
- Wind speeds are fairly light, generally less than 4.5 m/s.

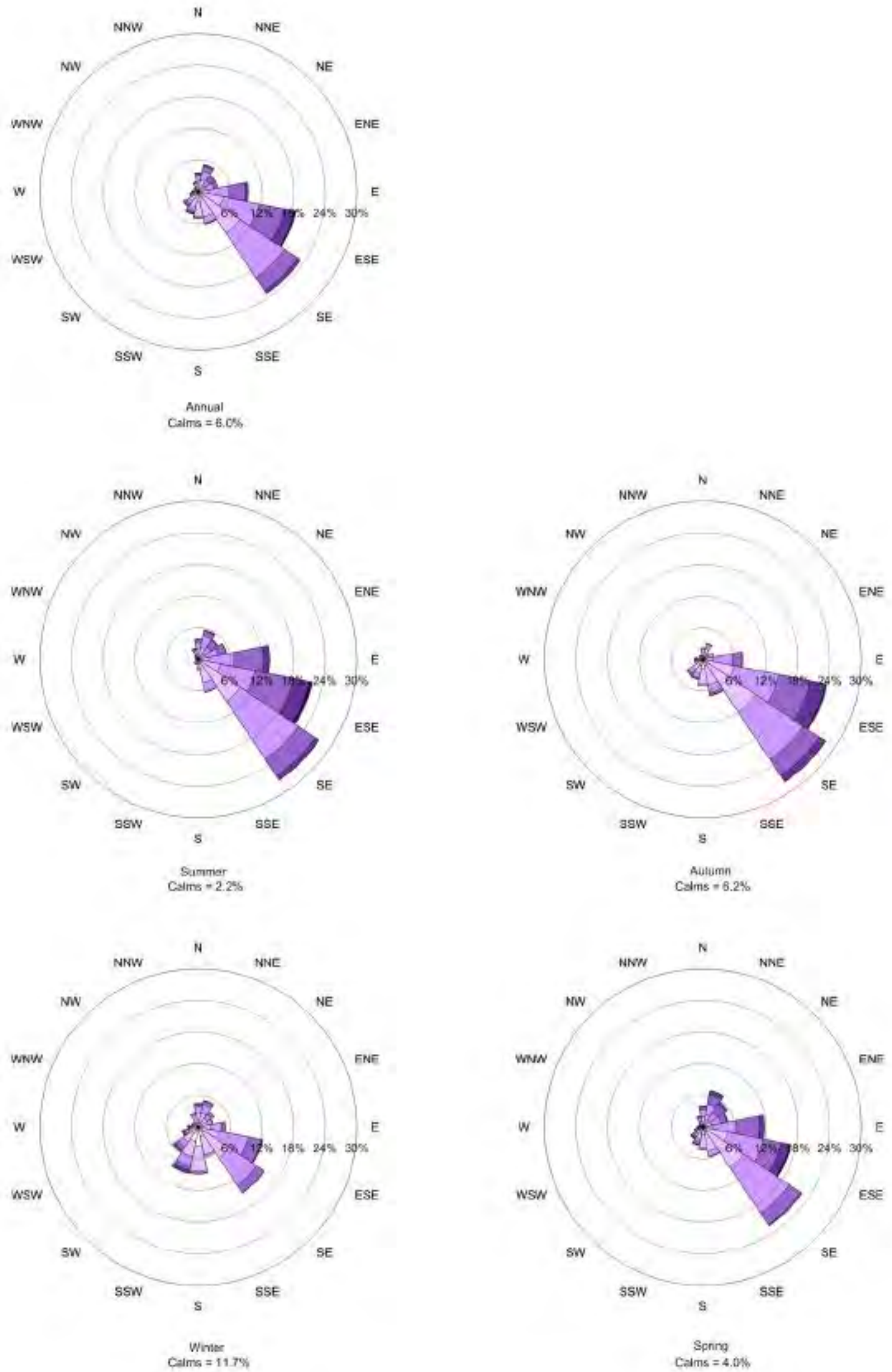
The prevailing wind patterns as recorded by BOM at Rockhampton in 2009 and 2010, are presented in **Figure 4-5**. Hourly data averages have been presented based on one minute data points. The general features of the wind environment at Rockhampton are:

- Winds are predominantly from the southeast;
- Winds are light with a mean wind speed of 3.8 m/s;
- Summer, autumn and spring winds are representative of the annual data;
- Winter winds are light and are predominantly from the southeast and south; and
- Calm wind conditions occur for a low proportion of the year (6%).



Source: BOM, 2011

Figure 4-4: Annual and seasonal windroses for Moranbah meteorological monitoring station 1986-2005 (readings at 6am, 9am, 3pm) (BOM site 034038)



Source: BOM, 2011

Figure 4-5: Annual and seasonal windroses for Rockhampton Aero meteorological monitoring station for 2009 and 2010 (hourly average wind readings) (BOM site 034038)

Climatic extremes

The potential risks of climate extremes that could affect the project are examined in a preliminary climate change risk assessment (Refer to **Table 4-6**). Hazards and risks associated with natural hazards (floods, bushfires, landslides and earthquakes) are examined in **Section 4.13** of the EIS.

Drought

Drought is part of the natural variability of the Australian climate. Since 1950, drought has occurred during most decades, from 1963 to 1971, between 1983 and 1988 and from 2000 to 2007. Droughts are not considered a risk for either construction or operation of the project.

Flooding

Queensland experienced widespread flooding during La Niña years of 1916, 1917, 1950, 1954-1956, 1973-1975 and 2010-2011. The proposed pipeline transects several watercourses, including the Fitzroy and Isaac rivers and a number of creeks and gullies. The Fitzroy River at Rockhampton has a long and well documented history of flooding, with flood records dating back to 1859.

Watercourse crossings will be required for pipe laying and the movement of construction equipment. Watercourse crossings will be vulnerable to flooding, erosion, scour or landslip. Flooding is considered a potential risk during construction and these impacts have been assessed in more detail in **Section 4.5**.

The pipeline is buried and is considered immune to flooding impacts during operation. The potential for flooding will need to be considered in the design and location of any above ground structures (eg main line valves / scraper stations).

Cyclones

A tropical cyclone is a tropical depression of sufficient intensity to produce sustained gale force winds (at least 63 km/h) (BOM, 2011). Over the past 100 years, relatively few cyclones have been experienced in the project area. In the average cyclone season, ten tropical cyclones develop over Australian waters, of which six cross the coast, mostly over northwest Australia (between Exmouth and Broome), and northeast Queensland (between about Mossman and Maryborough).

The most significant impact from tropical cyclones is destructive cyclone winds and flooding. During construction, the potential for cyclones will be monitored through local and regional weather forecasts. Flooding is considered a potential risk during construction and these impacts have been assessed in more detail in **Section 4.5**.

Given the capacity of the cyclone monitoring and warning system operated by BOM and that the proposed pipeline is underground, the risks from destructive cyclone winds affecting the project should be low.

Severe storms

Hot, humid, unsettled weather conditions or an approaching cold front or trough provide ideal conditions for severe thunderstorms, resulting in flash flooding, large hail, destructive wind gusts, and potentially tornadoes.

Severe storms are considered a potential risk during construction, although they are likely to be relatively short in duration. During construction, the potential for extreme climatic events will be monitored through regional and local weather forecasts and storm warnings.

Bushfires

Bushfire risk mapping, as modelled by the Rural Fire Service of the Queensland Fire and Rescue Service, has been prepared for Whitsunday, Isaac, Rockhampton and Gladstone Regional Councils. This shows that the majority of the proposed pipeline route runs through low or medium risk areas, although small pockets of high risk areas are identified, as described in **Section 4.13**. Bushfires are considered a potential risk during construction.

4.1.2. CLIMATE CHANGE ADAPTATION

Climate change risk assessment

A preliminary climate change risk analysis has been undertaken to identify key risks to the project. The following climate change risks were considered for the risk evaluation:

- Change in annual average temperatures;
- Change in seasonal average rainfall; and
- Change in annual average potential evaporation.

The *Climate Change in Australia Technical Report* (CSIRO & BOM, 2007) provides climate change projections. The projected climate change predictions are summarised in **Table 4-5**. The 50th percentile changes for 2030, 2050 and 2070 for medium and high emissions scenarios, considered to be the ‗best' or most central estimate of the projected change, are shown.

Table 4-5: Predicted climate change for the project area under medium and high emissions scenarios (relative to 1990)

Climate change parameter	2030	2050	2070
Increase in annual average temperature	+0.6 to +1°C	+2 to +2.5°C	+2.5 to +3.0°C
Decrease in annual average rainfall	-2 to -5%	-10 to -20%	-20 to -40%
Change in seasonal average rainfall:			
- Summer	-2 to -5%	-5 to -10%	-10 to -20%
- Autumn	-2 to -5%	-5 to -10%	-10 to -20%
- Winter	-2 to -5%	-5 to -10%	-10 to -20%
- Spring	-2 to -5%	-10 to -20%	-20 to -40%
Increase in annual average potential evaporation	+0.2 to +4%	+4 to +8%	+8 to +12%

Source: Climate Change in Australia Technical Report 2007 (CSIRO & BOM 2007)

While the quality of evidence for climate change is rapidly evolving, the following changes are likely to occur over the next 60 years:

- An expected increase in high temperatures and the number of days over 35°C;
- Reductions in annual average rainfall;
- Reductions in seasonal average rainfall; and
- Increased evaporation.

The climate change modelling also predicts the potential for increased inundation and erosion as a result of more intense weather systems and an increase in wind speeds.

Based on the above information, the main potential climate change risks to the project were identified to arise from:

- Dry conditions, leading to the potential risk of long term environmental damage, particularly through vegetation loss and soil erosion. Fires and duststorms may also increase in duration and frequency during dry periods;
- Potential accelerated deterioration of infrastructure, due to the projected increases in the number of days of extreme heat (days over 35°C);
- Increasing wind speeds, which may exacerbate the intensity of fires and duststorms during dry periods; and
- Inundation and erosion of the project infrastructure arising from the higher intensity, frequency and duration of extreme rainfall events.

With respect to cyclones, regional studies indicate a likely increase in the proportion of tropical cyclones in the more intense categories, but a possible decrease in the total number of cyclones (CSIRO & BOM 2007).

The climate change risk assessment is provided in **Table 4-6**. This examines potential impacts during the construction and operation of the project. Appropriate mitigation or adaptation measures are suggested to mitigate potential risks associated with climate change.

Table 4-6: Climate change risk assessment for the project

Climate change parameter	Potential impact on project	Risk mitigation strategy (mitigation and adaption options)
Increase in annual average rainfall and runoff	Construction infrastructure at increased risk of flooding, erosion, scour or landslip, resulting in delays. Restrictions on vehicular access to and from construction worksites affected by flooding, intense rainfall and runoff.	**Construction** **Climate** Prepare and implement a construction Emergency Response Plan. Take account of seasonal conditions when scheduling construction works. Ensure works at watercourse crossings are scheduled during the drier months to minimise potential erosion or sedimentation. Monitor potential for flooding (e.g. flash floods) during construction. Refer to: **Section 4.2**, **Section 4.5** and **Chapter 5**.
		Operation **Extreme climatic events and climate change** Ensure the location of above ground operational infrastructure has considered potential impacts arising from flooding. Refer to: **Section 4.2**, **Section 4.5** and **Chapter 5**.

Climate change parameter	Potential impact on project	Risk mitigation strategy (mitigation and adaption options)
Increase in annual average temperature	Potential increase in vulnerability from fires. Construction works at risk of water shortages during dry periods. Construction workforce at risk from risk of over-exposure to ultraviolet (UV) radiation in sunlight, heat stroke, fainting, heat exhaustion etc.	**Construction** **Climate and seasons** Prepare and implement a Fire Risk Management Plan. Plan availability of water resources to ensure sufficient supplies during construction. At temporary workers‘ accommodation camp sites identify and implement measures to maximise the use of grey water or capture, store and use stormwater for construction activities. **Extreme climatic events** Conduct health risk assessments on outdoor work scheduled for the hot summer periods when UV radiation and heat levels peak, Reduce UV exposure and heat levels to personnel using a hierarchy of controls, including: - Providing appropriate protective clothing i.e. clothing covering as much exposed skin as possible, clothing, hats and sunglasses; - Applying sunscreen; - Providing cool drinking water near the work site; - Providing employees with information, instruction and training on recognising heat-related illness and on first aid. and - Providing first aid facilities and access to medical help. Refer to: **Section 4.11**, **Section 4.13** and **Chapter 5.**
	Potential increase in vulnerability from fires.	**Operation** **Extreme climatic events and climate change** Ensure that the operational easement is periodically slashed to minimise fuel loads in the event of fires. Refer to **Section 4.11**, **Section 4.13** and **Chapter 5.**

Climate change parameter	Potential impact on project	Risk mitigation strategy (mitigation and adaption options)
Extreme climatic events, e.g.: cyclones, severe storms.	Damage to construction worksites and equipment, leading to delays to construction Delays to the transportation of construction components, materials, plant and equipment Injuries or incidents to the construction workforce	**Construction** **Extreme climatic events** Prior to the start of construction, develop and implement an Emergency Response Plan and Fire Risk Management strategies that considers the potential risks associated with extreme climatic events during construction. Monitor the potential for extreme climatic events through local and regional weather forecasts and storm warnings.
		Operation **Extreme climatic events and climate change** Develop and implement a Fire Risk Management Plan. Refer to: **Section 4.11**, **Section 4.13** and **Chapter 5.**

Mitigation and adaptation measures

The climate change risk assessment presented in **Table 4-6** suggests mitigation and adaptation strategies for the project to reduce the level of risk anticipated to arise from climate change projections. These comprise a combination of short, medium and long term measures, which include:

- Implementing specific management strategies (e.g. soil erosion and sediment control, fire risk management, emergency response management) during construction to minimise potential impacts from adverse climatic events;
- Monitor local and regional weather forecasts and review the potential impact to the construction schedule; and
- Consider the likelihood of extreme weather e.g. flooding in the location of above ground infrastructure.

The results of flood events and the potential impact on above ground infrastructure are presented in **Section 4.5**, as parts of the pipeline are located within potentially flood affected areas. Construction scheduling in these locations should consider the possibility of flooding from extreme rainfall events.

An emergency response plan will be developed prior to the commencement of construction works which will consider potential event risks associated with construction including flooding and other natural hazards such as landslides (refer to **Section 4.13**). Fire risk management will need to be addressed in the project's Health, Safety and Environment (HSE) plan to minimise the possibility of fire during construction and operation.

The proposed pipeline route will be constructed and operated in accordance with AS 2885 and buried to a minimum depth of cover of 750 mm which will protect the pipeline from potential climatic hazards, such as cyclones and bushfires.

Potential impacts arising from climatic factors are addressed in the relevant sections of the EIS as follows:

- Land (soil erosion) - **Section 4.2**;
- Water (rainfall and flood potential) - **Section 4.5**; and
- Hazard and risk (natural hazards e.g. floods, bushfires, landslides and earthquakes) - **Section 4.13**.

The climatic features of the project area have been considered in the management of the project (including air quality in **Section 4.6**). The potential risks posed by climate change will be reviewed during detailed design and prior to construction to ensure that the potential for flooding and other potential risks associated with climate change are considered in the location of permanent above ground inftfastructure. Arrow is committed to undertake, where practicable, a cooperative approach with government, other industry and sectors to address adaptation to climate change.

4.1.3. SUMMARY

Local climate, extreme climatic events and climate change have the potential to impact on the project during construction and operation.

The climate of the project area is predominantly sub-tropical, with temperatures varying from warm to hot in summer, to mild to cool in winter with large daily variations. The project area has limited vulnerability to climatic extremes, which include cyclones, floods, drought and fires. There is a potential risk from bushfires, severe storms and from periodic flooding associated with cyclone events. Local climate and extreme climatic events may temporarily impact on construction scheduling, but will not normally adversely affect the operation of the project in the long term.

The findings of a preliminary climate change risk assessment show the project has limited vulnerability to climate change projections over the operational life of the pipeline. The proposed mitigation measures will effectively manage and reduce the potential severity of impacts arising from seasonal changes, extreme climatic events and predicted climate changes on the natural environment and the construction workforce.

The project commitments with regard to climate change are summarised in **Table 4-7**.

Table 4-7: Project commitments for climate

Issue	Commitments
Rainfall / flooding	The potential for flooding from extreme weather events should be considered when determining the location of above ground structures and temporary workers' accommodation camp sites.
	Trenching of watercourse crossings should be completed promptly and with due regard to the weather.
Bushfires	An Emergency Response Plan will be prepared by the Construction Contractor.
	Fire risk management strategies will be addressed in the project's Health, Safety and Environment (HSE) Plan.

4.2. LAND

This section describes the existing environmental values of the land within the project area that may be affected by the project. It identifies and discusses the legislative objectives and practical measures for protecting or enhancing land-based environmental values.

Legislation, policies and guidelines

The assessment of land values associated with the project is based on applicable legislation, policies and guidelines outlined in **Table 4-8**.

Table 4-8: Legislation, policies and guidelines for land

Legislation, policies, guidelines	Relevance
Land use	
Coastal Protection and Management Act 1995 (Coastal Act)	▪ Provides for protection, conservation, rehabilitation and management of the coastal zone. ▪ The State Coastal Management Plan and Regional Coastal Management Plans have been developed under the Coastal Act. ▪ The applicable regional plan is the *Curtis Coast Regional Coastal Management Plan* (Curtis Coast Plan). Refer to **Section 1.5.2.1**.
Sustainable Planning Act 2009 (SP Act) and Sustainable Planning Regulation 2009 (SP Regulation)	▪ The SP Act and the SP regulation are the overarching planning legislation for development within Queensland. ▪ The SP Regulation identifies exempt development, self-assessable development, assessable development and compliance assessment development. Refer to **Section 1.5.2.1**.
State Development and Public Work Organisation Act (SDPWO) and *State Development Area* (SDA) development schemes	The proposed pipeline route transverses land included in the SGIC SDA and the GSDA. As such consideration needs to be given to: ▪ The *Development Scheme for the Stanwell-Gladstone Infrastructure Corridor State Development Area*; and ▪ The *Development Scheme for the Gladstone State Development Area*. Refer **Section 1.5.1.2**.
Strategic Cropping Land Bill	▪ Regulates impacts on Queensland‘s best cropping land. ▪ It should be demonstrated, where possible, that the project will not cause permanent damage to cropping land. Refer **Section 1.5.2.5**.

Legislation, policies, guidelines	Relevance
State Planning Policies (SPPs)	SPPs considered for the project include: ▪ SPP 1/92 *Development and Conservation of Agricultural Land*; ▪ SPP 1/03 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*; and ▪ SPP 2/02 *Planning and Managing Development Involving Acid Sulphate Soils*. ▪ *Curtis Coastal Regional Coastal Management Plan*. (Coastal Coast Plan) Refer **Section 1.5.2.4**.
Regional plans	The proposed pipeline route transverses land included in the *Draft Mackay, Isaac, Whitsunday Regional Plan*, the *Central Queensland Regional Plan (Central Queensland Regional Growth Management Framework)* and the Curtis Coast Plan. Refer **Section 1.5.2.6**.
Local government planning schemes	The proposed pipeline route traverses land included within the following seven local government planning schemes: - *Bowen Shire Planning Scheme 2006;* - *Nebo Shire Plan (February 2008);* - *Belyando Shire Planning Scheme;* - *The Broadsound Plan;* - *Livingstone Shire Planning Scheme;* - *Fitzroy Shire Planning Scheme;* - *Calliope Shire Planning Scheme 2007* Refer **Section 1.5.1.3**.
Contaminated land	
Environmental Protection Act 1994 (EP Act) and *Environmental Protection Regulation 2008* (EP Regulation).	The EP Act and EP Regulation regulate contaminated land matters. The EP Regulation identifies a number of notifiable activities that are likely to cause contaminated land. If land is, or has been, used for a notifiable activity, such land should be listed on the environmental management register (EMR).
National Environment Protection (Assessment of Site Contamination) Measure 1999	These guidelines provide a framework for assessing and managing contaminated soil and / or groundwater based on an evaluation of three components in the risk chain, identified below. Each of these components must be present and form a pollutant linkage for a risk to exist: ▪ Contamination source: soil and / or groundwater contamination must be present. Contamination is the release of a hazardous contaminant into the environment that is likely to cause serious or material environmental harm because of its physical, chemical, infectious characteristics or concentration. ▪ Receptors: humans and / or a receiving environment must be present and be potentially impacted by the identified contaminants. ▪ Pathways: the contamination must be able to contact
Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland	

Legislation, policies, guidelines	Relevance
	receptors by means such as — humans (ingestion, skin contract, and inhalation) and — the environment (seepage into waterways, wind-blown deposition on plants, root uptake).

Methodology

Topography

The assessment of the topography of the proposed pipeline route and the project area is predominantly based on a desktop review of existing topographical information. Where possible, the topography and slope has been confirmed in the field using visual observations. Information sources used for the desktop review included:

- A 90 m Digital Elevation Model (DEM); and
- Topographic 1:250,000 scale maps published by Geoscience Australia: Clermont, St Lawrence, Duaringa, Rockhampton, Mount Coolon.

Land use and Infrastructure

The description of land use and infrastructure is based on:

- A desktop assessment of relevant legislation and state, regional and local planning instruments including the development schemes for the SDAs and local government planning schemes;
- A desktop assessment of aerial photographs and maps of the project area;
- A site inspection of the project area (undertaken from 23 to 25 August 2011);
- A review of the Queensland Land Use Mapping Program[6] (QLUMP);
- A desktop assessment of land tenure and tenements; and
- A review of background project information e.g. technical reports.

[6] QLUMP maps and assessed patterns of land use and land use change across Queensland and includes 79 catchments across Queensland. The QLUMP data used to create mapping for the project is from 2004 and therefore changes to land uses may have occurred since this time. Observations have been used to confirm and update this data to the extent possible.

Geology and geomorphology

The geology, fossil occurrences and geomorphology of the project area and proposed pipeline route has been derived from the following 1:250 000 published geological maps:

- Mount Coolon (SF 55-7) (NRM GSQ, 1997);
- St Lawrence (SF 55-12) (NRM GSQ, 1970);
- Duaringa (SE 55-16) (NRM GSQ, 1982); and
- Rockhampton (SE 56-13) (NRM GSQ, 1974).

Soils

Soils along the proposed pipeline route have been described and mapped using existing published electronic maps including:

- Dominant soil types mapped by McKenzie and Hook (1992), using soil descriptions provided in the Atlas of Australian Soils (Northcote et. al. 1968);
- Digital map published by National Resource Information Centre(1991); and
- Atlas of Australian Soils (Northcote *et al*, 1960-68). Digital Map published by CSIRO.

Contaminated land

A limited Stage 1 Environmental Site Assessment was undertaken by SKM and was based on:

- A review of landholder survey results undertaken and recorded by Arrow‘s Land Liaison Officers;
- A review of available aerial imagery (Google Earth, 2005-2011) of the project area to assess features which may be potential notifiable activities; and
- A targeted search of DERM‘s Environmental Management Register (EMR) and Contaminated Land Register (CLR) based on anecdotal information provided by Arrow‘s Land Liaison Officers and landholders and findings from the review of aerial imagery.

No intrusive work was undertaken as part of Stage 1 Environmental Site Assessment. The interviews and information provided by Arrow has only been used as anecdotal evidence as the information provided at the time of the EIS preparation was not verified.

Environmentally Sensitive Areas

ESAs along the proposed pipeline route and within the project area have been identified by:

- A review of relevant Commonwealth and state legislation;
- A search of state databases; and
- A review of AECOM's *Environmental Assessment Report (Flora) for the Proposed Arrow Bowen Pipeline* (**Appendix A4.3**, **Volume 3**) and ECOSM's *Terrestrial Fauna Assessment* (**Appendix A4.4**, **Volume 3**).

Landscape character and visual amenity

The landscape character and visual amenity assessment has been based on:

- A review of Coffey's *Arrow Bowen Pipeline Proposed Alignment Travelogue* (2011);
- A desktop investigation including a review of maps and aerial photography;
- Ground truthing of sensitive receptors within the project area; and
- Site investigations of the project area carried out by SKM personnel between 1 and 16 August 2011.

Furthermore, the visual amenity impact assessment is based on the criteria outlined in **Table 4-9** and **Table 4-10** which have been developed to assess the level of visual amenity impact of the project on sensitive receptors.

Table 4-9: Visual amenity impact criteria

Criteria	Description
Distance	The greater the distance between the receiver and the proposed pipeline route, the less visual amenity impacted.
Size	The smaller the feature or activity, the less the visual amenity is impacted.
Context	The degree to which the project or activity is in character with the surrounding environment.
Activity levels	The less the activity levels (movements by car/trucks, reflection of light), the less the visual amenity is impacted.
Time	The shorter the activity timeframe, the less the visual amenity is impacted.
Change	The less change in the existing environment, the less the visual amenity is impacted.

Table 4-10: Level of visual amenity impact

Impact level	Description
Substantial adverse impact	The project will result in significant deterioration of the existing visual amenity.
Moderate adverse impact	The project will result in noticeable deterioration of the existing visual amenity.
Slight adverse impact	The project will result in barely perceptible deterioration of the existing visual amenity.
Slight beneficial impact	The project will result in a barely perceptible improvement to the existing visual amenity.
Moderate beneficial impact	The project will result in a noticeable improvement of the existing visual amenity.
Substantial beneficial impact	The project will result in a significant improvement of the existing visual amenity.
No change	No discernable deterioration or improvements to the existing visual amenity.

4.2.1. DESCRIPTION OF ENVIRONMENTAL VALUES

4.2.1.1. Topography

Topography along the proposed pipeline route is summarised in **Table 4-11**. Transects of ground elevation along the proposed pipeline route is provided in **Figure 4-6** and **Figure 4-7** and an elevation map is provided on **Map 4**, **Volume 2**.

Ground elevations generally decrease from the west to east from a maximum elevation of approximately 434 m Australian Height Datum (AHD) (AB26) at Mount Ewan to less than 5 m AHD at the Port Alma coastal plain, in the southeast section of the proposed pipeline route.

The proposed AB mainline starts at 350 m AHD approximately 90 km north of Moranbah, then travels southwards over the Denham Range reaching a maximum elevation of 434 m AHD before descending along the western flank of the Burton Range. The AB mainline then travels southeast over the southern tip of the Kerlong Range between approximately AB60 and AB80. From near Coppabella at approximately AB96 the AB mainline descends into the alluvial plains of the Mackenzie-Dawson lowlands intersecting the eastern flank of Mount Coxendean at around AB127 before crossing the Isaac River twice at around AB165 and AB234. The mainline traverses the Broadsound Range near Mt Gardiner at around AB275 reaching a maximum elevation of 191 m AHD.

From here, the AB mainline crosses levelled to undulating alluvial plains to the west of the Fitzroy River and tracks southwest of Rockhampton along the eastern base of Mount Morgan. The mainline then crosses the coastal plain of the Bajool - Port Alma area and the floodplain of Raglan Creek. The mainline ends in the hilly area east of Larcom Creek, approximately 22 km west of Gladstone. Slope was calculated using the 90 m DEM on a cell to cell basis. In general, the changes in height (slope) along the AB mainline are gentle (3% slope or less), with occasional steep slopes (7-15% slope) noted.

The Dysart Lateral elevation varies from 149 m AHD to 190 m AHD with gentle slopes from 0% to 2.7%. The Elphinstone Lateral elevation varies from 242 m AHD to 374 m AHD with gentle to moderately undulating slopes from 0% to 7.8%. The Saraji Lateral elevation varies from 169 m AHD to 215 m AHD with level and gently undulating plains with slopes from 0% to 3.4%.

Table 4-11: Topography of the proposed pipeline route

Section of proposed pipeline route	Landform	Elevation (m AHD)	Predominant slope (%)
AB mainline			
AB0 to AB111	Undulating to gently undulating lands, plateau and mesas with steep-scarped dissected margins. High hills or rugged mountains with massive sand-stone outcrops between AB20 to AB39 and AB55 to AB80, south of Glenden.	Between 204 m and 433 m	Slopes generally <3%, up to 6% in creeks and can reach 15% in mountainous area (AB73)
AB111 to AB255	Level alluvial plains subject to flooding particularly along the Isaac River.	Between 94 m and 247 m	Slopes are <1.5%
AB255 to AB305	Strongly undulating to very high hilly and mountainous lands of Mount Gardiner with igneous rock outcrops.	Between 96 m to 191 m	Slopes commonly <5% but slope can reach 15%
AB305 to AB358	Level alluvial floodplain of Fitzroy River to undulating lands, less commonly strongly undulating lands.	Between 24 m to 105 m	Slopes generally <3% but side slopes are up to 12%
AB358 to AB417	Low to steep hilly land from Mount Morgan with some rolling granitic area, rock outcrops and narrow valley plains.	Between 9 m and 100 m	Between 0- 6% but side slopes up to 14%
AB417 to AB447	Coastal plain at the west of Port Alma and low hills, undulating terrain to flat associated with Fitzroy River and Raglan Creek floodplain.	Between 2.6 m and 53 m	Generally <2% but can reach 3.1%
AB447 to AB477	Low rounded hills to mountainous country around Mount Larcom.	Between 44 m and 102 m	Slopes are typically <6% but side slopes up to 12.2%
Laterals			
EL0 to EL52	Moderately undulating with broad valleys becoming gently undulating or undulating.	Between 242 m and 374 m	Slopes are typically <5% but side slopes up to 7.8%.
SL0 to SL25.8	Gently undulating or level plains.	Between 169 m and 215 m	Slopes are typically <2% with side slopes up to 3.4%.
DL0 to DL25.7	Undulating or gently undulating plains and Level alluvial plains	Between 149 m and 190 m	Slopes are <2.7%

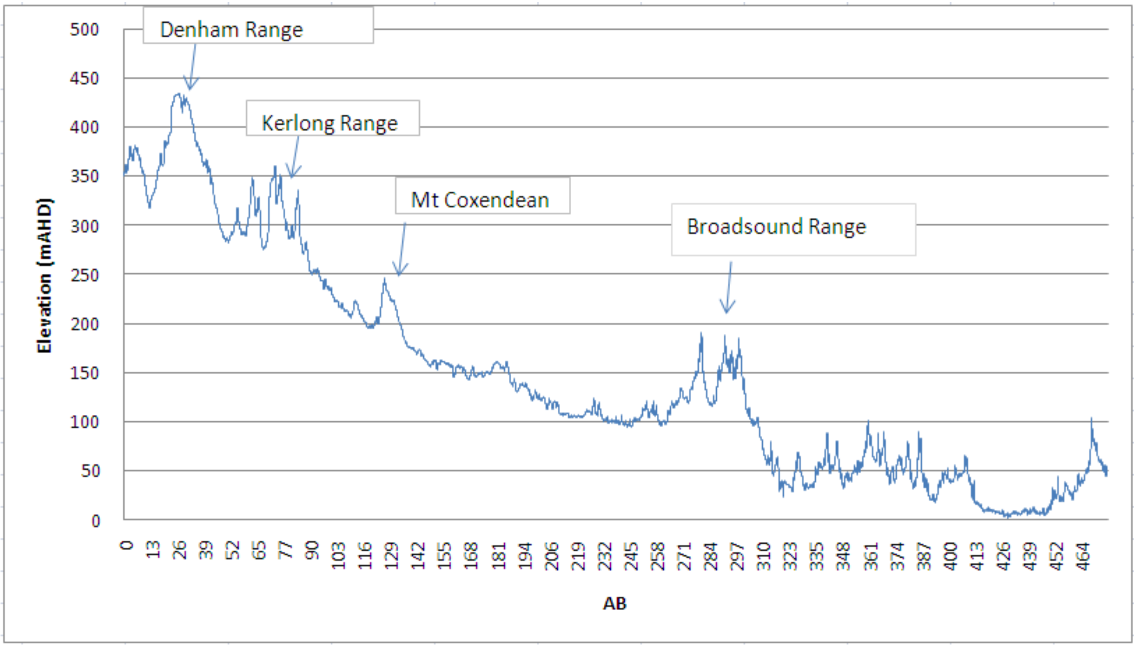


Figure 4-6: Transect of ground elevation along the AB mainline

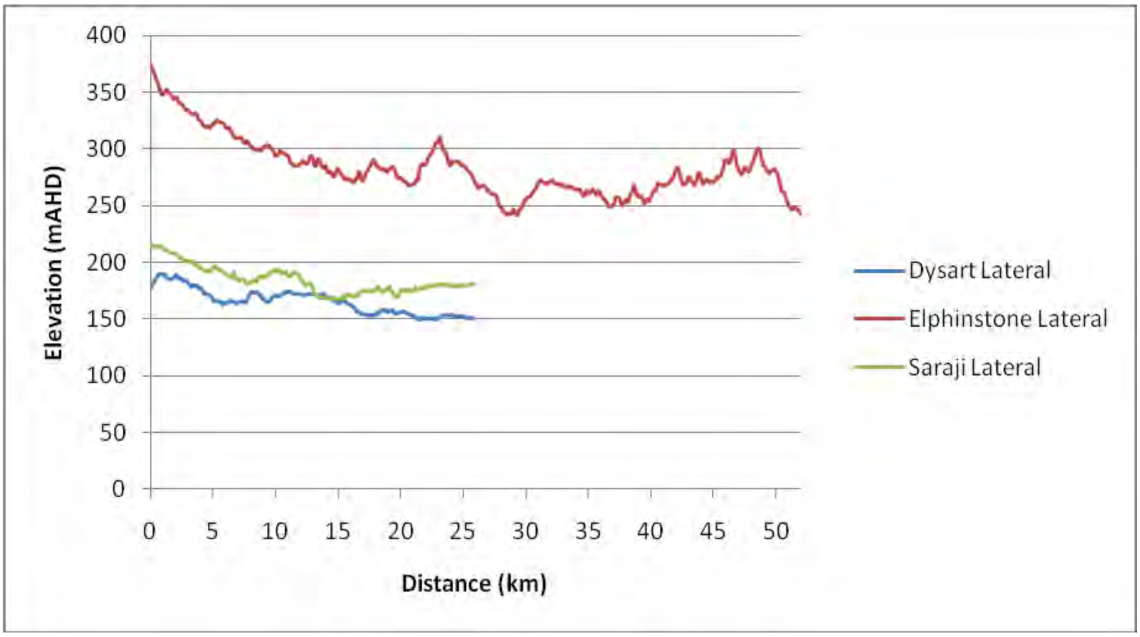


Figure 4-7: Transect of ground elevation along the EL, SL and DL

4.2.1.2. Land use

Land use is regulated under each relevant local government planning scheme (the proposed pipeline route traverses land within seven planning schemes as discussed in **Section 1.5.1.3**) and the relevant development scheme for the SGIC SDA and the GSDA (refer **Section 1.5.1.2**). Regional plans also influence land use (refer **Section 1.5.2.6**).

Under each planning scheme and development scheme, land is divided into land use classes or zoning which identify the preferred land use for a particular area / lot (e.g. rural, commercial, community purpose). The majority of land traversed by the proposed pipeline route is included in the rural land use class (96.62%). The land use classes for land traversed by the proposed pipeline route are outlined in **Table 4-12**.

All land impacted by the temporary workers‘ accommodation camps (as per current indicative locations – refer **Section 3.3.3**) is located within the rural land use class.

Table 4-12: Land use classes for land traversed by the proposed pipeline route (%)

Planning scheme / Development Scheme	% of land traversed by the proposed pipeline route intended for rural purpose	% of land traversed by the proposed pipeline route indented for community purpose	% of land traversed by the proposed pipeline route intended for other purpose
Bowen Shire Planning Scheme	1.13%	0%	0%
Nebo Shire Plan	19.25%	0%	0%
Belyando Shire Planning Scheme	2.50%	0%	0%
The Broadsound Plan	31.20%	0%	0%
Livingstone Shire Planning Scheme	9.75%	0%	0%
Fitzroy Planning Scheme	28.01%	0%	1.55% (includes land in the SGIC SDA)
Calliope Shire Planning Scheme	4.79	0.16%	1.67% (includes land in GSDA)
TOTAL	**96.62%**	**0.16%**	**3.21%**

Development on land within the rural land use class should support rural activities such as grazing, agriculture and horticulture. The rural land use class aims to protect GQAL and areas of natural and landscape significance. Residential dwellings are consistent land uses within this land use class.

Land designated for community purposes generally supports development such as a community hall, open space or public facility. Land identified 'for other purpose' in **Table 4-12** includes land intended for special purposes which differs depending on the planning scheme e.g. for the *Livingstone Shire Planning Scheme*, a special purpose includes cultural, educational or religious purposes.

For land included in the GSDA, the applicable land use class as per the development scheme for the GSDA is the ~~"~~Materials Transportation and Services Corridor". The Materials Transportation and Services Corridor Precinct comprises four corridor sub-precincts including Boat Creek Corridor, Western Corridor, Northern Infrastructure Corridor and Curtis Island Corridor and the purpose of each corridor is:

- To establish the propriety in the Materials Transportation and Services Corridor Precinct of materials transportation infrastructure and utility and service infrastructure over alternative land uses;
- To provide an efficient and effective route for infrastructure and utility services to link the Port of Gladstone with the Gladstone precincts and areas external to the GSDA;
- To provide for infrastructure that may or may not be associated with activities within the GSDA;
- To provide for multiple users and for multiple purposes in the Materials Transportation and Services Corridor Precinct. Appropriate uses include pipelines for potable and sea water, sewage, slurry and gas as well as conveyor systems, rail lines, industry construction and operation haul roads, and any other compatible infrastructure services;
- To develop the Materials Transportation and Services Corridor Precinct in a manner that efficiently uses the land in the corridor;
- To recognise the requirements of existing users' infrastructure in considering the appropriateness of future infrastructure; and
- To encourage and promote infrastructure having regard to the cultural heritage values of the Materials Transportation and Services Corridor Precinct.

The potential impacts of the project on the development intention of each land use class traversed by the proposed pipeline route are provided in **Section 4.2.2.1**.

The predominant existing land uses within the project area are reflective of the current land use classes traversed by the proposed pipeline route and include:

- Agriculture, in particular cropping and grazing;
- Residential dwellings;

- Some community buildings;
- Infrastructure, including roads and railways (refer **Section 4.2.1.6**);
- Coal mines; and
- Conservation areas.

A more detailed assessment of the current land uses within a 1 km buffer either side of the proposed pipeline route follows.

It is noted that land constraints such as flooding, steep slope and nature conservation areas may also dictate current and future land uses and such constraints are discussed in **Section 4.1.3**. Native title can also impact upon the development of land as it describes the rights and interests of Aboriginal people and Torres Strait Islander people under their traditional laws and customs. Native title along the proposed pipeline route is addressed in **Section 4.9**.

Agriculture and grazing

From AB150 the majority of land within the project area is rural (both freehold and leasehold) and is used for farming enterprises such as broad acre cropping and grazing. Of this cropping and grazing land, the *Soils Assessment* (**Appendix A4.10**, **Volume 3**) identified that:

- Strategic cropping land (SCL) is not traversed by the proposed pipeline route;
- The majority of land traversed by the proposed pipeline route, being 86%, is Class C Good Quality Agricultural Land (GQAL) (refer **Table 4-13** and **Map series 9**, **Volume 2**); and
- The remainder of land traversed by the proposed pipeline route comprises 10.4% Class A GQAL, 3.2% Class B GQAL and 0.2% of Class D GQAL (refer **Table 4-13** and **Map series 9**, **Volume 2**).

Table 4-13: Description of land classes and proposed pipeline coverage

Class	Description	Approximate Area (ha)[1]	Percentage of Pipeline and Laterals Route[1]
Class A Crop Land	Crop land - Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels.	181	10%
Class B Limited Crop Land	Limited crop land - Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.	57	3%

Class	Description	Approximate Area (ha)[1]	Percentage of Pipeline and Laterals Route[1]
Class C Pasture Land	Pasture land - Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment.	1,500	86%
Class D Non-agricultural Land	Non-agricultural land - Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage.	0.5	<1%

[1] The approximate areas and percentages of GQAL traversed by the proposed pipeline route are based on a 30 m wide ROW.

Further, in accordance with the Land Suitability Assessment Techniques in the *technical Guidelines for the Environmental Management of Exploration and Mining in Queensland*, the proposed pipeline route traverses land classed as:

- Class 4 (land primarily used for pastoral uses but can be occasionally carefully cropped);
- Class 5 (land primarily used for pastoral uses but can be cropped if limitations are removed); and
- Class 7 (land not suitable for cultivation and only careful pastoral use possible). This only applies to the steeper, hillier parts of land crossed by the proposed pipeline route.

Land use suitability and classes are shown in **Map 5, Volume 2**.

Residential dwellings and community buildings (sensitive receptors)

119 residential dwellings have been identified within a 1 km buffer either side of the proposed pipeline route. Only two houses are located within 100 m of the ROW at AB398 (approximately 77 m from the proposed pipeline route) and AB440 (approximately 92 m from the proposed pipeline route).

Further the following facilities have been identified within 1 km of the proposed pipeline route:

- One police station (Mt Larcom) (AB468);
- One library (Mt Larcom) (AB468);
- Mount Larcom Ambulance Station (AB468); and

- Mount Larcom State School (AB467).

Sensitive receptors are shown on **Map series 8**, **Volume 2**.

Coal mines

Mining tenements constrain land within the project area from AB0 to about AB150 (and associated laterals). The Eastern Creek colliery, Newlands colliery and Goonyella Riverside colliery are the main coal mines within the project area occupying these tenements.

The tenements of land within the project area are described in **Section 3.3.1** and shown on **Map 2**, **Volume 2**.

Quarries

The proposed pipeline passes in the vicinity of, but does not transect, two DERM hard rock quarries located near the Peabody Burton coal mine at AB72 and AB74. Lisison with the operators of these quarries are being undertaken to determine any potential impacts from future operations or expansion to these quarries may have on the proposed pipeline.

Conservation areas

The proposed pipeline route traverses four state reserves; three unnamed and Boveys Lookout as shown on **Map series 8**, **Volume 2** and described as follows:

- Unnamed state reserve one comprises approximately 0.36 hectares of the proposed pipeline route which equates to 0.03% of the reserve;
- Unnamed state reserve two comprises approximately 0.08 hectares of the proposed pipeline route which equates to 0.01% of the reserve;
- Unnamed state reserve three comprises approximately 3.16 hectares of the proposed pipeline route which equates to 0.22% of the reserve; and
- Boveys Lookout is a hill at an altitude of approximately 514 m above sea level located approximately 50 km from Moranbah. Approximately 5.65 hectares of the proposed pipeline route (between AB 38.8 and AB 40.8), which equates to 0.39% of the reserve, is located in the flat area of the Boveys Lookout reserve.

4.2.1.3. Geology and geomorphology

The western part of the proposed pipeline route lies within the Carmila Beds of the Bowen Basin which occupies about 160,000 km^2 of eastern Queensland. The Bowen Basin was formed by fluvial and lacustrine sediments and volcanics which were deposited in the eastern section of the basin, and a thick succession of coals and non-marine clastics were deposited in the western section of the basin. It has a maximum sediment thickness of approximately 10,000 m which is concentrated in two north trending depocentres comprising the Taroom Trough to the east and the Denison Trough to the west. The southeast section of the proposed pipeline route traverses a small part of the Gogango Overfold Zone and the Yarrol Province. The Gogango Overfold Zone consists of strongly cleaved sedimentary and some volcanic rocks. The Yarrol Province is characterised by volcaniclastic sediments, coralline limestone lenses, and deformed ultra mafic and mafic rocks.

The geology of the project area is shown in **Map series 6**, **Volume 2**. The geology and geomorphology provided in **Table 4-14** is based on 1:1,000,000 electronic vector geological mapping data (Geoscience Australia, 2002). A description of the major lithology is provided in **Appendix A4.11**, **Volume 3**.

Table 4-14: Geological characteristics of the project area

Distance (KP)	Geological formation (primary unit)	Period or era
AB0 to AB28	Mafic volcanic rock	Cainozoic
	Rewan Group	Triassic
AB28 to AB74	Sutton Formation	Cainozoic
	Colluviums	Quaternary
	Rewan Group	Triassic
	Alluvium	Quaternary
	Ferruginous duricrust	Cainozoic
	Mafic volcanic rocks	Cainozoic
AB74 to AB93	Blackwater Group	Late Permian
AB93 to AB142	Sand plain	Cainozoic
AB142 to AB180	Duaringa Formation	Late Eocene
AB180 to AB227	Back Creek Group	Late Permian
AB227 to AB261	Trachyte	Cainozoic
AB261 to AB279	Lizzie Creek Volcanics	Permian
AB279 to AB307	Carmila beds	Early Permian
AB307 to AB313	Sedimentary rocks	Cainozoic
AB313 to AB316	Rookwood Volcanics	Early Permian
AB316 to AB234	Rockhampton Group	Early Carboniferous
AB324 to AB328	Craigilee beds	Early Devonian
AB328 to AB348	Mount Alma Formation	Early Carboniferous
AB348 to AB354	Ridgelands Granodiorite	Early Triassic
AB354 to AB358	Mount Alma Formation	Early Carboniferous
AB358 to AB360	Alton Downs Basalt	Late Cretaceous
AB360 to AB392	Mount Salmon Volcanics	Cretaceous
AB392 to AB396	Kabra Quartz Monzodiorite	Triassic
AB396 to AB411	Bundaleer Tonalite	Early Triassic
AB411 to AB472	Mafic intrusives	Cretaceous

Distance (KP)	Geological formation (primary unit)	Period or era
AB472 to AB477	Berserker Group	Permian
EL0 to EL11.4	Rewan group	Triassic
EL11.4 to EL12.8	Alluvium	Quaternary
EL12.8 to EL23.8	Sedimentary rocks	Cainozoic
EL23.8 to EL52	Sand plain	Cainozoic
SL0 to SL26	Sand plain Alluvium	Cainozoic Quaternary
DL0 to DL19.7	Duaringa formation Sand plain	Middle Eocene Quaternary
DL19.7 to DL21.1	Blackwater group	Late Permian
DL21.1 to DL26	Sand plain	Cainozoic

Faulting

Faulting occurs in land following seismic activity and is caused by increased pressure between two tectonic plates. The proposed pipeline route crosses several faults, some of which may be active. Historically, movement from faults has occurred during periods of active mountain formation; however it is likely that some of these faults have been stable since that time.

The Saraji Lateral crosses several unnamed faults trending north to northeast and south to southwest at approximately SL7, SL9 and SL20. These faults cut quaternary alluviums and colluviums. Faulting is most extensive towards the southern section of the proposed pipeline route.

From the northwest to southeast the AB mainline crosses a fault bounding the Back Creek Group formation and the Blackwater Group formation at approximately AB180. The area between AB275 and AB320 is associated with the Gogango Overfold Zone, considered as the more intensely deformed part of the Bowen Basin. Within this area, the AB mainline crosses several faults which bound the Carmila Beds and the Back Creek Group and cut the Rockhampton Group formation, the Craigilee Beds, the Rookwood Volcanics formation and quaternary alluviums.

A geotechnical desktop study (Arup, 2011) identified one potentially active fault that crosses the project area, being the Dee Range/ Midgee Fault which mainly trends north-south. The proposed pipeline route runs along the Dee Range / Midgee Fault for approximately 14 km, between AB411 and AB425.

A review of records held by Geoscience Australia (2011) show that there were 23 earthquakes in the project area since records began in 1955. Only two were classed as ‗significant' with magnitudes of 3.6 and 4.2. The 3.6 magnitude earthquake occurred in 1990 at 10 km below surface and was possibly associated with a concealed fault where the pipeline crosses at approximately AB121. Six earthquakes with magnitudes of between 0.8 and 2.9 appear to have occurred near the proposed pipeline route in the Bajool area near Port Alma in association with the deformed zone between AB427 and AB428. The remainder of the recorded earthquakes do not appear to be associated with faults where the proposed pipeline route crosses.

Low to intermediate seismic events have occurred in the project area during the last 120 years (Arup, 2011). The largest earthquake in Queensland occurred offshore at Gladstone in 1918, with a Richter magnitude estimate of ML=6.3 based on felt area. Recent earthquakes in the Moranbah area demonstrate that certain faults in the Bowen Basin are active. This includes an earthquake that measured 5.2 on 17 April 2011 and another that measured 4.1 on 19 September 2011. Earthquakes in the Moranbah area with magnitudes generally less than 4.0 are attributed to significant mining operations.

A preliminary assessment of potential areas of liquefaction in the event of an earthquake was also undertaken as part of the geotechnical desktop study (Arup, 2011). Liquefaction is the process in which soil loses cohesion when subject to seismic activity (i.e. shaking). Areas of potential liquefaction identified as part of the preliminary geotechnical investigations include fine sandy soils, Quaternary and younger unconsolidated geologic units and alluvial deposits.

A geotechnical desktop study undertaken by Arup (2011) identified 12 areas of potential slope instability where the proposed pipeline routes crosses steep slopes and a possible ancient landslide.

Fossil occurrences

The 1:250 000 published geological maps of the Bowen Basin shows several sites where fossils have been found in the project area including:

- Fossil site approximately 12 km east of AB100;
- Fossil site approximately 20 km southwest of AB253;
- Fossil sites approximately 2 km southwest of AB256;
- Fossil sites approximately 7 km southwest of AB262;
- Fossil sites approximately 1 km southwest of AB390; and
- Fossil sites approximately 3 km south of AB444.

4.2.1.4. Soils

This section describes soils according to the CSIRO Australian Soils Classification (Isbell, 2002). A field survey to ground truth the soil classifications was undertaken by SKM between 15 and 23 August 2011 and findings are reported in the *Soils Investigation Report* included at **Appendix A4.9**, **Volume 3** and on **Map series 7**, **Volume 2**.

A summary of the soil types along the proposed pipeline route according to the Australian Soil Classification, the likely soils descriptions based on the Digital Atlas of Australian Soils (National Resource Information Centre, 1991), electronic mapping and dominant geology according 1:1,000,000 electronic vector mapping data (Geoscience Australia, 2002) is provided in **Table 4-15**.

Table 4-15: Summary of soils along proposed pipeline route

Australian Soil Order	Location and percentage of total soils along the pipeline	%	Soils description	Dominant parent geology
Vertosols	Between AB0 – AB18.3 AB92.4 – AB109.26 AB133.1 – AB146.66 AB164.7 – AB218.5 AB229.66 – AB273.86 EL47.32 – EL51.98 SL17.48 – SL25.88 DL0 – DL25.76	32%	▪ shallow to deep dark clays and slightly gilgaied clays ▪ dark grey or dark brown cracking clays ▪ red friable earths	Mafic volcanic rock and Rewan Group, Sand plain, Duaringa Formation, Back Creek Group, Trachyte, Sedimentary rocks, alluvium, sandplain, Blackwater Group
Sodosols	Between AB18.3 – AB92.4 AB109.3 – AB133.1 AB146.7 – AB164.68 AB294.1 – AB299.68 AB361.1 – AB425.84 AB441.4 – AB477.26 EL0 – EL47.3 SL0 – SL17.46	50%	▪ sandy to loamy mottled duplex soils of shallow to moderate depth ▪ hard alkaline, neutral and acidic yellow soils (some with yellow mottling) ▪ hard acidic red soils and red friable earths ▪ deep sandy or loamy red earths	Sutton Formation, Colluviums, Rewan Group, Alluvium, ferruginous duricrust, mafic volcanic rocks, Blackwater Group, sand plain, Duaringa Formation, Carmilla Beds, Mount Salmon Volcanics, Kabra Quartz Monzodiorite, Bundaleer Tonalite, mafic intrusive, Berseker Group, Sedimentary rocks
Chromosols	Between AB322.06 – AB361.08	7%	▪ loamy red duplex soils of shallow to moderate depth ▪ shallow mostly gravelly loamy duplex soils	Craigilee beds, Mount Alma Formation, Ridgelands Granodiorite, Alton Downs Basaslt

Australian Soil Order	Location and percentage of total soils along the pipeline	%	Soils description	Dominant parent geology
Rudosols	Between AB273.88 – AB322.04	7%	▪ shallow stony loams ▪ fairly shallow often stony loamy duplex soils. ▪ shallow stony clay loams	Backcreek Group, Rockwood Volcanics
Kandosols	Between AB218.14 – AB229.64	2%	▪ deep dark clays ▪ sandy or loamy duplex soils with moderately deep A horizons	Duaringa Formation, Alluvium
Hydrosols	Between (as per mapping only – not proven by field sampling) AB425.86 – AB441.38	3%	▪ hard neutral yellow and yellow mottled soils	Alluvium

The physical and chemical properties of each soil type identified in **Table 4-15** in terms of their influence over erosion potential, stormwater run-off quality, rehabilitation and agricultural productivity of the land is described as follows.

Vertosols

Montmorillonite is the main clay mineral in these vertosols leading to significant shrinking and swelling with changing soil moisture contents. Vertosols are often described as selfmulching due to the development of a fine aggregate assemblage on the surface. They have a very low erosion hazard given their high clay content and low position in the landscape, but sheet erosion is common when groundcover is removed. Land with vertosols is used for grazing of native and improved pastures, extensive dry land agriculture where rainfall is adequate and irrigated agriculture.

Sodosols

Sodosols are mildly acidic to alkaline duplex (i.e. they display a strong texture contrast between surface (A) horizons and subsoil (B) horizons) soils with high levels of exchangeable sodium cations in the subsoil. When sodic soils are wet, each clay particle becomes surrounded by a significant water film which forces the particles away from each other. When this happens, the clay particles are said to have dispersed. The dispersed particles are seen as cloudy water in runoff. Dispersible soils are of concern to farmers because they are easily eroded by water. Erosion in sodic soils is often in the form of gully and tunnel erosion.

Land with sodosols is used for grazing of native or improved pastures for both dry land and irrigated agriculture and forestry. Generally, sodosols have very low agricultural potential with high sodicity leading to high erodibility, poor structure and low permeability. These soils have low to moderate chemical fertility and can be associated with soil salinity.

Chromosols

These soils are found in imperfectly drained sites (yellow and grey chromosol) where rainfall is between 250 mm and 900 mm. They are also found in well-drained sites (brown and red chromosol) with rainfall between 350 mm and 1400 mm. The soils usually have fine loamy surfaces overlying clayey soils with mottles. Sheet erosion and gully erosion is likely if protective vegetative cover is removed.

These soils have moderate agricultural potential with moderate chemical fertility and water-holding capacity. They can be susceptible to soil acidification and soil structure decline.

Rudosols

Rudosols are stony soils with no real soil horizons (layers). They are found on steeper slopes where much of the soil has eroded away, and on dunes, and are also formed on recent sediment within floodplains. The soils saturate rapidly in heavy rain, leading to early runoff.

They are highly erodible, particularly on slopes where there is minimal vegetation due to poor nutrient levels. These soils are best left under natural cover to reduce the erosion hazard, which is high.

Land use where these soils are present is widespread because of their properties or occurrence in arid regions or both. In contrast, fertile variants formed in alluvium are used for cropping and improved pastures.

Kandosols

These soils are generally uniform throughout the profile and lack structure. They are usually loamy with a gradual increase in clay content at depth. Freshly turned, they are dull and dusty rather than shiny like clay soils. Differences in subsoil colour are due to several factors, including drainage and parent material.

Red Kandosols occur in several isolated patches underlain by igneous, sedimentary and metamorphic rocks. The topsoil is sandy clay loam, changing to light clay at depth. They are generally very permeable, well drained and highly erodible.

Yellow Kandosols are yellow due to poorer drainage, but the colour may only reflect that of the parent material. The topsoil is grey brown to brown and below that yellowish

Kandosols are highly erodible and have low to moderate agricultural potential with moderate chemical fertility and water-holding capacity. Land use is generally restricted to grazing of native pasture. Grazing lands are susceptible to surface soil degradation such as hardsetting and crusting even though grazing intensity is low.

Hydrosols

These are wet soils of coastal and inland swamps. Those on the coastal floodplains often contain potential acid sulfate soils (ASS). These wet soils are generally characterised by a bluish grey subsoil, a reflection of the lack of oxygen available.

Given their location and high clay content, they are highly unlikely to erode. However, acid scalds may be subject to wind erosion.

Most non-saline hydrosols require drainage for land use other than grazing such as those under sugarcane in coastal Queensland. Drainage of potentially acid sulphate hydrosols can pose engineering and environmental problems and lead to acidification.

Erosion potential

The potential for soil erosion to occur as a result of construction of the proposed pipeline is discussed in detail in the *Soils Assessment Report* in **Appendix A4.10**, **Volume 3**.

Estimated erosion ratings (calculated in tonnes per hectare per year) for the proposed pipeline route based on data from a hillslope erosion map of Australia produced by CSIRO National Land and Water Resource Audit (2001) is shown in **Figure 4-8**. The erosion rating is categorised as High (>10 t/ha/yr), Medium (between 0.5 and 10 t/ha/yr) and Low (<0.5 t/ha/yr), based on the Australian Agriculture Assessment 2001 reporting (Land & Water Australia, 2001).

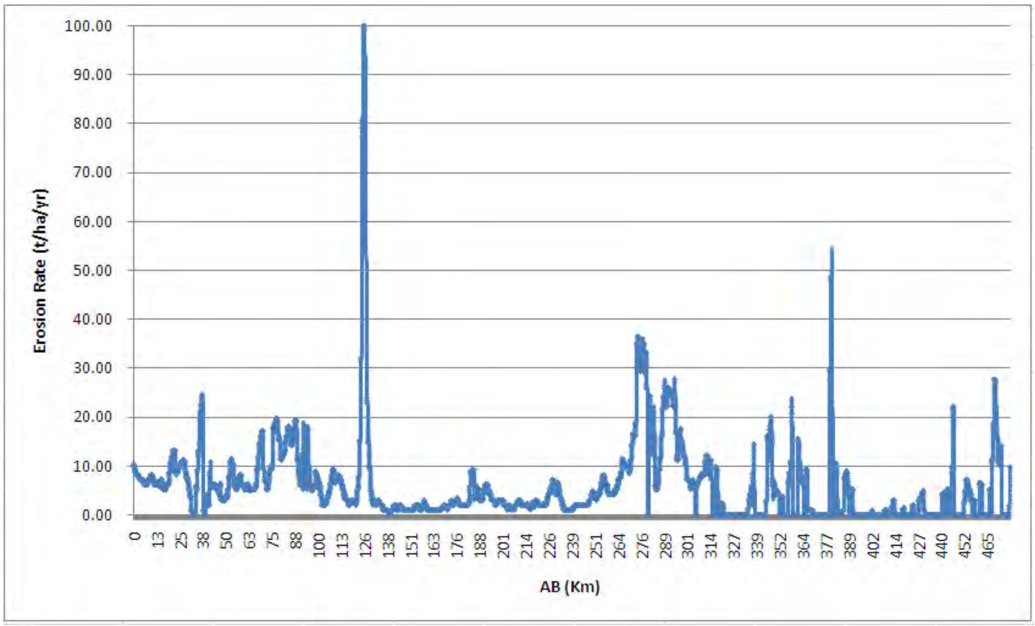


Figure 4-8: Predicted soil erosion ratings along AB mainline

The erosion potential of the laterals is shown in **Figure 4-9**. The Saraji Lateral traverses land that is predominately of medium erosion potential (95%) and a small amount of land that has a low erosion potential (5%). The Dysart Lateral traverses land that is of medium erosion potential. The Elphinstone Lateral traverses land that is predominately of high erosion potential (57%) with the remainder being of medium erosion potential (43%).

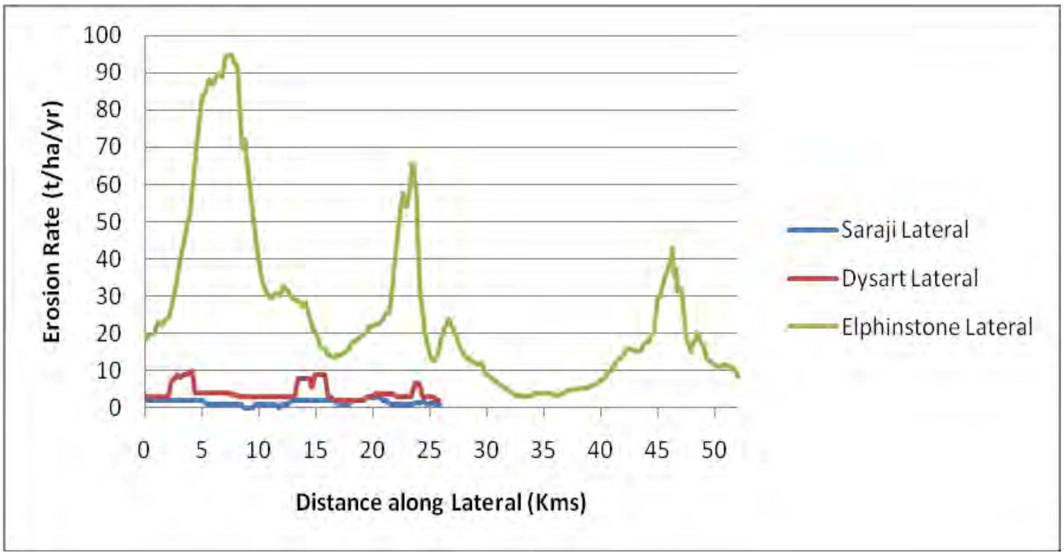


Figure 4-9: Predicted Soil Erosion Ratings along Laterals

The proposed pipeline route crosses land with high annual hillslope erosion yields (>10 t/ha/yr) which generally correspond to steeper hilly sections of the project area (e.g. Kerlong, Broadsound and Boomer Ranges) or Sodosol areas.

Construction practices aimed at reducing erosion and sediment transport will be adopted at all times and additional measures will be taken in areas of high erosion potential as outlined in **Section 4.2.2.4**.

Topsoil

Interrogation of CSIRO topsoil thickness mapping provided in the *Soils Assessment Report* (**Appendix A4.10**, **Volume 3**) indicates that the estimated topsoil thickness does not exceed 410 mm along the proposed pipeline route. Variation in topsoil thicknesses (estimated to range from 100 mm to 410 mm) roughly corresponds to soil type and landform. Topsoil thickness along the proposed pipeline route is shown in **Figure 4-10** and **Figure 4-11**.

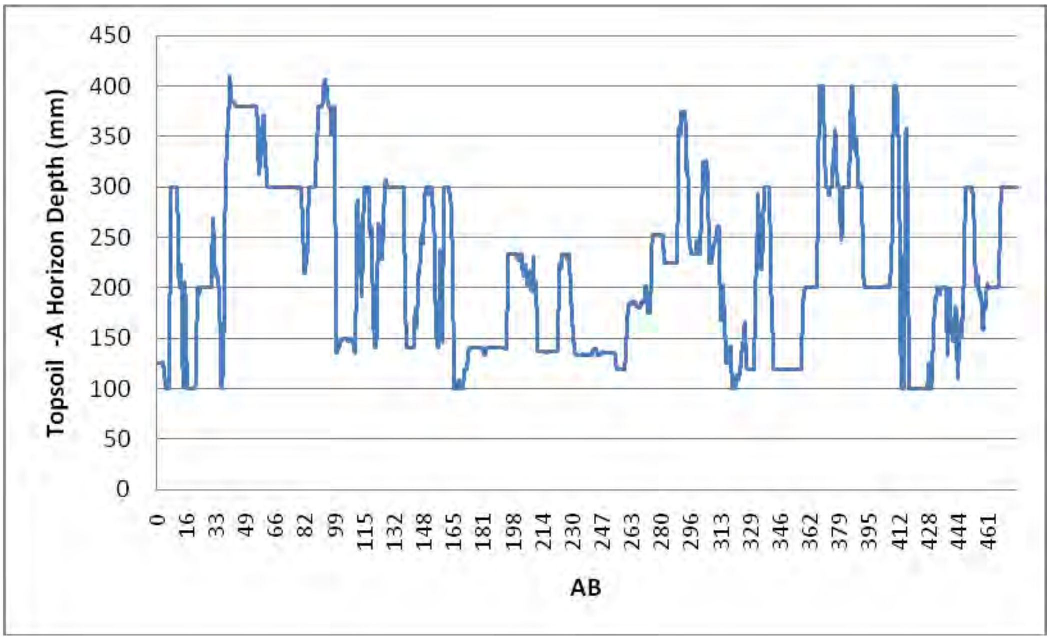


Figure 4-10: Predicated topsoil thickness along AB mainline (mm)

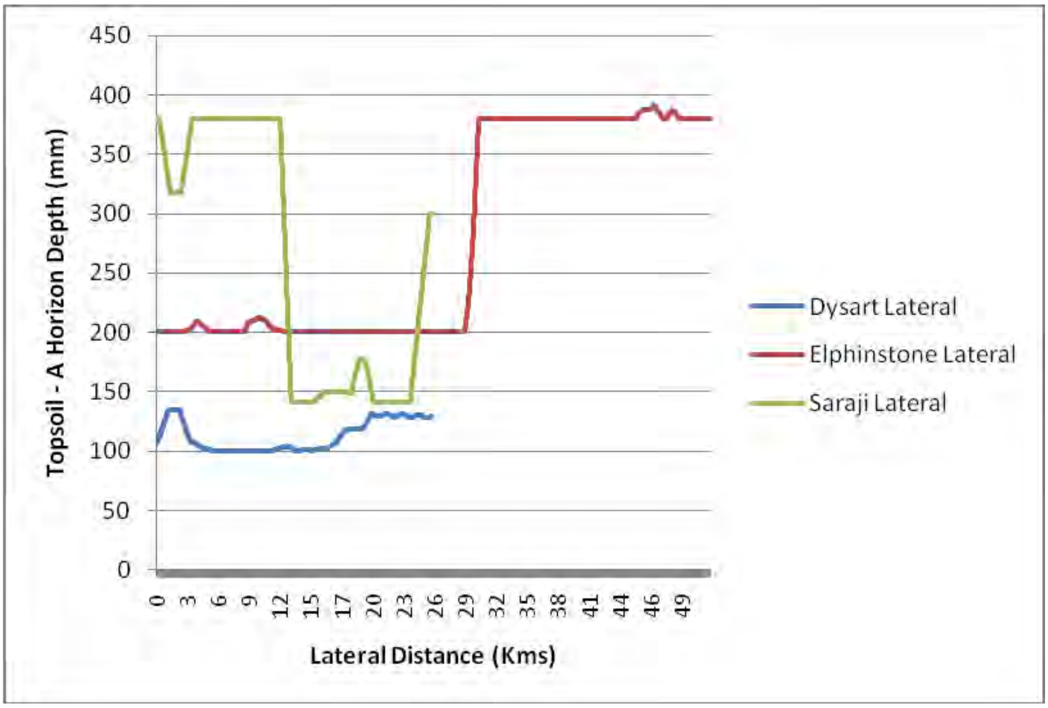


Figure 4-11: Predicted topsoil thickness along Laterals (mm)

The field investigation found that topsoil depth varied from 100 mm to 1,000 mm (which varies from the CSIRO topsoil thickness) across the 36 survey sites along the proposed pipeline route. Topsoil depths classified according to observed ASC Order are presented in **Table 4-16**, and indicate considerable variability both within and between Orders.

Table 4-16: Field investigation topsoil summary

ASC observed	Number of sites sampled	Minimum topsoil depth (mm)	Maximum topsoil depth (mm)	Average topsoil depth (mm)
Vertosols	4	300	600	413
Sodosols	18	150	1,000	536
Chromosols	1	250	250	250
Rudosols	3	100	250	167
Kandosols	1	190	190	190

Acid Sulfate Soils

ASS refers to soil that produces sulfuric acid and often releases toxic quantities of iron, aluminium and heavy metals. ASS can only occur in soils that contain iron sulfides which have been exposed to the air after being disturbed and can cause damage to buried structures and the surrounding environment. Deposits of ASS are commonly found in soils on land less than 5 m above sea level, particularly in low-lying coastal areas including mangroves, salt marshes, floodplains, swamps, wetlands, estuaries and brackish or tidal lakes.

No ASS is mapped for the length of the proposed pipeline route (as per current maps published by the Queensland Government National Resources and Water, 2007). However, there may be some soils classed as having a high probability for presence of ASS or potential acid sulphate soils (PASS) in the low lying areas of Bajool - Port Alma area.

State Planning Policy (SPP) 2/02 *Planning and Managing Development Involving Acid Sulfate Soils* applies to development on land where the natural ground level is less than 20 m AHD and where it involves filling or excavating 100 m^3 or more of material below 5 m AHD. The proposed pipeline route passes through some land at or below 20 m AHD and therefore SPP 2/02 may apply to the project during construction of the pipeline trench and for HDD. SPP 2/02 recognises that the potential adverse affects of disturbance can be avoided or minimised by treatment and, in some cases, by ongoing management.

The *Soil Assessment Report* (**Appendix A4.10**, **Volume 3**) includes the analysis of two soil samples from Sample 14 (14/0.3-0.4 m and 14/0.6-0.7 m) located within the low lying area near AB431 shown in **Map series 7**, **Volume 2**. These samples did not contain detectable levels of oxidisable sulphur and are not considered to be ASS.

Further investigation may be required during detailed design to assess the potential for presence of ASS near Port Alma.

4.2.1.5. Contaminated land

Contaminated land refers to land contaminated by hazardous substances which may pose a risk to human health or the environment (DERM, 2011). The majority of the proposed pipeline route traverses non-industrial land (native vegetation or agricultural land) which is generally not considered to have potential for land contamination. An exception to this would be points of settlement within agricultural land (e.g. farm buildings and sheds or current / former cattle dips), which do pose the potential for contamination sources to be present.

Arrow's land agents interviewed all impacted landholders along the proposed pipeline route gathering information on former land use activities. Several potential notifiable activities (stock dips, landfills, hazardous substance storage) were identified by the landholders as being located on the same lot traversed by the proposed pipeline route but away from the proposed pipeline route and construction area. Refer to **Table 4-17**. A review of the EMR and CLR was undertaken for these lots and none were listed on either register as identified in **Table 4-17**.

Table 4-17: Targeted EMR/CLR search results

AB (approximate)	Likely Location	Potential Feature	Lot EMR/CLR Status
5-26	Activity not within 1 km of pipeline	Landfill, dip/spray race	Not on EMR/CLR
103	Activity not within 1 km of pipeline	Landfill, hazardous contaminant	Not on EMR/CLR
103-107	Activity not within 1 km of pipeline	Landfill, hazardous contaminant	Not on EMR/CLR
103-110	Activity not within 1 km of pipeline	Landfill, hazardous contaminant	Not on EMR/CLR
114-116	Activity not within 1 km of pipeline	dip/spray race	Not on EMR/CLR
126-122	Activity Location unknown	Landfill	Not on EMR/CLR
146-154	Activity not within 1 km of pipeline	Landfill	Not on EMR/CLR
154-165	Activity not within 1 km of pipeline	hazardous contaminant	Not on EMR/CLR
183-186	Activity not within 500 m of pipeline	dip/spray race	Not on EMR/CLR
186-193	Activity not within 500 m of pipeline	dip/spray race	Not on EMR/CLR
193-195	Activity not within 500 m of pipeline	dip/spray race	Not on EMR/CLR

AB (approximate)	Likely Location	Potential Feature	Lot EMR/CLR Status
222-228	Activity Location unknown	Landfill	Not on EMR/CLR
228-234	Activity not within 500 m of pipeline	dip/spray race	Not on EMR/CLR
273-280	Activity not within 500 m of pipeline	dip/spray race	Not on EMR/CLR

In addition to landholder interviews, a review of available Google Earth imagery (2005 to 2011, depending on the section of the proposed pipeline route) was undertaken for the length of the proposed pipeline route. The review identified six possible stockyards and one area of disturbed land (possible landfill) adjacent to the proposed pipeline route (refer **Table 4-18**). These sites may have been subject to existing or former land uses involving possible notifiable activities. However, a search of the EMR and CLR revealed they are not listed as notifiable activities as identified in **Table 4-18**.

Table 4-18: Targeted EMR/CLR search results

AB	Location	Identified Feature from aerial photography	EMR / CLR Status
369.8	120 m southwest of mainline	Stock Yard 6 (Livestock dip or sprayrace)	Not on EMR/CLR
395.7	190 m west of mainline	Stock Yard 5 (Livestock dip or sprayrace)	Not on EMR/CLR
409.6	209 m north of mainline	Stock Yard 2 (Livestock dip or sprayrace)	Not on EMR/CLR
410.8	AB410.8	Disturbed land	Not on EMR/CLR
443.5	40 m south of mainline	Stock Yard 4 (Livestock dip or sprayrace)	Not on EMR/CLR
448.8	96 m north of mainline	Stock Yard 3 (Livestock dip or sprayrace)	Not on EMR/CLR
468.1	On mainline	Stock Yard 1 (Livestock dip or sprayrace)	Not on EMR/CLR

A visual inspection along the full length of the proposed pipeline route will be undertaken as part of the pipeline pre-construction survey. The locations of the potential notifiable activities listed in **Table 4-18-** and **Table 4-18-** will be targeted to confirm the location and presence of these activities.

Unexploded ordinance

A search of the Department of Defence online unexploded ordinance (UXO) mapping database (2011) showed that land within the project area was not listed as potentially containing unexploded military ammunition or explosives. The closest area listed for UXO is near Lake Learmouth, located approximately 4 km northeast of AB348.

4.2.1.6. Infrastructure

The major roads, stock routes and railways within the project area are identified within **Section 3.4.1.1**, **Section 3.4.1.2** and **Section 3.4.1.3** respectively. They are also shown on **Map series 8**, **Volume 2**.

In summary, the proposed pipeline route traverses the Bruce, Peak Downs, Burnett and Capricorn highways as well as 11 major formed roads, six stock routes and seven railway lines. The proposed pipeline route also lies within 25 km of a number of airports and airstrips (refer **Section 3.4.1.5**).

The proposed pipeline route transects ten powerlines, two buried gas pipelines including the Gladstone to Rockhampton Gas Pipeline and the Wallumbilla to Gladstone Gas Pipeline and four water pipelines (one above ground and three buried).

4.2.1.7. Environmentally Sensitive Areas

ESAs are detailed in **Section 4.8** of the EIS and in the *Environmental Assessment Report (Flora) for the Proposed Arrow Bowen Pipeline* in **Appendix A4.3**, **Volume 3**. Desktop investigations identified the following ESAs within the project area:

- Endangered REs (Category B);
- Of Concern REs (Category C);
- Protected Area Estates, including State forests and nature refuges (Category C); and
- Essential habitat (Category C).

A summary of each ESA is provided in **Table 4-19**.

Table 4-19: Environmentally sensitive areas

Environmentally sensitive area	Summary
Endangered REs	Endangered REs comprise 0.44 km of the proposed pipeline route which equates to 0.07% of the proposed pipeline route.
Of Concern REs	Of Concern REs comprise 27.8 km of the proposed pipeline route which equates to 4.79% of the proposed pipeline route.
Protected Area Estates	The proposed pipeline route does not transverse or lie adjacent to any Protected Area Estates, however, there are six state forests and four nature refuges within 5 km of the proposed pipeline route. No national parks or world heritage areas occur with 5 km of the proposed pipeline route.
Essential habitat	Essential habitat for *Eucalyptus raveretiana* (black ironbox), which is listed as Vulnerable under both the NC Act and the EPBC Act, occurs within the 5 km buffer area and within the ROW. The ROW contains 0.7 ha of essential habitat and is mapped by DERM near the crossing of Limestone Creek from AB367-370. Field surveys recorded black ironbox from one occurrence of essential habitat from AB371.2-371.3. Essential habitat for one fauna species, Little Pied Bat (*Chalinolobus picatus*), which is listed as Near Threatened under the NC Act, occurs within the ROW. The ROW contains 6.25 ha of essential habitat for Little Pied Bat. The essential habitat area is located at AB75, an area found to support caves and ledges which provide habitat for a range of Microchiropteran species.

4.2.1.8. Landscape character

The landscape character of the project area can be characterised as predominately rural, comprising a mixture of vegetated and cleared open land located on flat and undulating topography. The southern areas are dominated by extensive sandstone ranges and lowlands with ridges.

The proposed pipeline route traverses, or lies adjacent to, numerous creeks, tributaries, gullies and rivers, including the Fitzroy River and the Isaac River. A number of these watercourses and gullies suffer from significant erosion and a number of watercourses have been dammed for potable water extraction/supply. Areas of gilgai (water holes) are also located along the proposed pipeline route (mainly in the northwest) and freshwater wetlands are located towards the southeast of the AB mainline.

Vegetation along the proposed pipeline route can generally be characterised as areas of degraded remnant vegetation, endangered and immature regrowth, riparian vegetation, scattered/outlier trees and woodlands of varying density and intact vegetation communities. Species include poplar box woodland, brigalow woodland, red gum/poplar box woodland and mountain coolibah. In some areas vegetation has been cleared for cropping and improved grazing pasture. It is noted that grazing pressures have resulted in surface erosion in some locations in the north.

Human influences on the landscape include homesteads, stockyards, small private dams, outbuildings, property/landholder fencelines and access tracks.

The proposed pipeline route also traverses, or lies adjacent to, road and railway infrastructure as outlined in **Section 4.2.1.6**. In addition there are a number of power transmission lines, including the Nebo-Moranbah 132 kV overhead transmission line and the Broadsound-Lilyvale 275 kV transmission line traversed by the proposed pipeline route.

The landscape character in the surrounding areas along the route has also been influenced by the mining industry, with a number of collieries and their access/haul/dragline routes, including the Norwich Park Colliery, Eastern Creek and Newlands Colliery found in the first 150 km of the proposed mainline.

4.2.1.9. Visual amenity

Visual amenity is a measure of the visual quality of a site or area experienced by residents, workers or visitors (sensitive receptors). The proposed pipeline route traverses mainly flat rural land with scattered houses located on small-acre lots. There are a number of sensitive receptors within 1 km either side of the proposed pipeline route including 119 residential dwellings, one school, one ambulance station, one police station and one library.

The proposed pipeline route is also located adjacent to a number of major roads and highways (e.g. Fitzroy Development Road (AB142.15 to AB152.75 and DL20 to DL25.7), Golden Mile Road (DL0 to DL20) and the Bruce Highway (AB413 to AB422.6)). Major roads and highways are considered to be sensitive receptors only to the extent that views are altered for vehicle occupants.

The impact of the project on the visual amenity of the sensitive receptors during construction and operation is discussed at **Section 4.2.2.6**.

4.2.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

4.2.2.1. Land use and suitability

This section assesses the potential for the project to impact the current and future use of land traversed by the proposed pipeline route.

As discussed in **Section 4.2.1.2** the main current land uses traversed by the proposed pipeline route are rural. Other current land uses within a 1 km buffer of the proposed pipeline route include community use and residential uses. An assessment of the project‘s impact on the current land uses is provided in **Table 4-20**.

Table 4-20: Assessment of project impacts on current land uses

Existing land use	Potential impacts
Rural	Current rural uses include grazing, cropping, agriculture. It is expected that the project will have limited impacts on rural activities as land is intended to be returned to its original condition post construction. The installation of the pipeline and ancillary infrastructure, if not managed appropriately, however, has the potential to degrade GQAL and other agricultural land through clearing, loss of topsoil, topsoil / subsoil mixing, topsoil compaction and erosion. A more detailed assessment of the project's impacts on GQAL and SCL is provided in the *Soils Assessment Report* included in **Appendix A4.10**, **Volume 3**.
Community use	The proposed pipeline route does not directly traverse any community uses within the project area. The closest community use, being a library, is located 74 m away from AB468. There are only three other community uses within close proximity to the proposed pipeline route, as identified in **Section 4.2.1.2,** namely a school, ambulance station and police station. Such community uses may be temporarily impacted during construction of the project by transport, air, noise, visual amenity (refer to **Section 4.3**, **Section 4.6**, **Section 4.7** and **Section 4.2.2.6** respectively), however, there will be no impacts on existing community uses during operation of the pipeline.
Residential	The nearest residential dwelling is located approximately 80 m away from the proposed pipeline route. Furthermore there are 119 residential dwellings within 1 km of the proposed pipeline. There may be temporary impacts on residential dwellings during construction of the project (e.g. transport, air, noise, and visual amenity – refer to **Section 4.3**, **Section 4.6**, **Section 4.7** and **Section 4.2.2.6** respectively), however, such impacts are expected to be minimal. Construction of the proposed pipeline route at any one point in time is expected to be a few weeks. No existing residential dwellings will be impacted by the project during operation as the proposed pipeline route does not directly traverse any existing houses within the project area.

The future use of land traversed by the proposed pipeline route is largely determined by the relevant land use class as identified within the development schemes for the SDAs and the relevant local government planning scheme (as discussed in **Section 4.2.1.2**). Regional Plans may also impact upon future land use development (applicable regional plans are discussed in **Section 1.5.2.6**). An assessment of the project's impact on the future intended land uses as per the land use classes traversed by the 30 m operational easement is provided in **Table 4-21**.

Table 4-21: Assessment of project impacts on future land uses

Land use class	Potential impacts
Rural	Land included within the rural land use class is intended to be used for rural activities. The pipeline, once operational, is not expected to have major impacts on agricultural activities such as grazing and cropping. Vegetation will be able to grow over the pipeline easement once operational. The pipeline, once operational, is also not expected to impact greatly on GQAL as the disturbed area from construction will be rehabilitated as quickly as possible and returned to its original condition. A more detailed assessment of the project's impacts on GQAL and SCL is provided in the *Soils Assessment Report* included in Appendix A4.10, Volume 3. The location of temporary workers' accommodation camps located in the rural land use class may impact on land intended for agricultural purposes and GQAL, however such impacts will be assessed within separate development applications post EIS approval.
Community purpose	Only 0.16% of land traversed by the pipeline easement is intended for community purpose (as per the planning scheme land use classes). The project may impact on the location of structures associated with a community purpose however is not expected to have a major impact on the overall development of land for community purpose.
Other	This land use class includes land intended for: - Open space and recreation; - Major infrastructure; and - Land included in both SDAs. Land designated for open space and recreation is unlikely to be impacted by the project during operation as uses will be able to continue over the operational easement. Land intended to be developed for major infrastructure is unlikely to be heavily impacted by the project. <u>GSDA – Materials Transportation and Services Corridor</u> As described in Section 4.2.1.2, this precinct supports infrastructure including gas infrastructure and therefore the project is consistent with the intent of the GSDA. <u>SGIC SDA</u> The proposed pipeline route is consistent with the intent of the SGIC SDA.

As per **Table 4-20** current land uses may be temporarily impacted by the construction of the project in terms of impacts from transport, air, noise and visual amenity which are discussed in **Section 4.3**, **Section 4.6**, **Section 4.7** and **Section 4.2.2.6** respectively. Impacts on current land uses once the pipeline is operational will be minimal. The majority of the proposed pipeline route traverses rural land (grazing and cropping), with the land use continuing over the ROW following completion of construction and rehabilitation activities (e.g. soils will be returned to its original condition and crops will be able to grow over the top of the pipeline). Mitigation measures to assist with this include:

- Compensate landholders for any temporary disruption to agricultural production during the construction of the pipeline;
- Carrying out work in accordance with the project EMP to avoid or minimise impacts; and
- Returning the ROW to the former land use following completion of construction and rehabilitation.

The only restrictions on future land uses from the project are that no deep-rooted vegetation will be allowed to grow over the pipeline easement and no structures or buildings will be able to be built over the operational easement in line with standard easement conditions.

4.2.2.2. Land disturbance

Temporary land disturbance impacts will occur during construction. Land disturbance will include clear and grade to provide a 30 m wide construction ROW. The ROW will be cleared of vegetation and levelled to the required gradient. Topsoil will be removed to its full depth (typically to a depth of 100 to 300 mm) over the trench line and will be stockpiled separately from subsoil as outlined in **Section 3.2**. The rate of excavation of the trench will be dependent on terrain and weather conditions, but is anticipated to be at a production rate of approximately two kilometres per day. The depth of cover (typically 750 mm), and therefore the trench depth (typically 1,800 mm), is dependent on the current or anticipated land use.

Potential impacts from the project on current land use within the ROW are considered as follows:

- Reduced moisture retention (through reduction in pore space from soil compaction) especially in subsoils (where present) outside of the trench;
- Reduced infiltration through compaction of subsoils outside of the trench and dispersed topsoil and therefore decreased water availability;
- Increased root penetration resistance (through compaction of subsoils) outside of the trench and therefore decreased plant water availability;
- Increased erosion levels through dispersion of topsoil and reduced infiltration through subsoils;
- Loss of topsoil (and resultant loss in fertility) through stripping, storage and replacement;
- Increased penetration resistance through surface crusting (dispersion of topsoil); and
- Increased infiltration within the trench itself potentially resulting in an area prone to waterlogging within subsoils returned to the trench.

Clean-up, restoration and rehabilitation measures will be applied to all areas disturbed during construction, including the ROW and access tracks, as soon as practical after pipe laying and backfill. This includes removal of construction material and waste, surface contouring, respreading topsoil and reseeding/revegetation (typically via natural regeneration or seeding of native grass or matching improved pasture species as required). The landscape will be rehabilitated to pre-existing contours with natural drainage lines restored and protected if required. In certain cases, rehabilitation will be tailored to site-specific conditions in consultation with the landholder. All land disturbed by the construction activities will be stabilised as soon as practicable and the productivity of the affected land is expected to return, as near to its pre-disturbance levels, as is practicable.

Monitoring activities include post-construction audits to be conducted annually for two years to evaluate revegetation, erosion control, weed control, watercourse integrity and success of bed and bank reprofiling. Areas of high erodibility will be monitored more regularly.

Ground truthing and testing during detailed geotechnical investigations will be used to determine the geological risk of locating the proposed pipeline route in areas of faults, land slips, earthquakes and potential instability. This will allow a better determination of the risk and the selection of appropriate management or mitigation strategies.

Excavation of the trench for the proposed pipeline route during construction may expose fossils, particularly where the proposed pipeline route crosses low ridges. However, it is unlikely that new faunas or species would be revealed as the fossil faunas of the Bowen Basin are well-known from 1950s and 1960s regional mapping and associated paleontological studies. No mitigation measures for fossil occurrences are considered necessary during pipeline construction.

4.2.2.3. Land degradation or contamination

Land degradation

The impacts and mitigation measures for land degradation as the same as those discussed in **Section 4.2.2.2**.

Contamination

Smaller quantities of chemicals, fuels and oils will be stored in self-bunded pallets, within a bunded area in the workshop, or in a bunded container on the site. Bulk quantities of diesel will also be kept in double skinned tanks (self-bunding) or within an appropriately bunded area.

Hazardous waste products, (e.g. oil/water separator waste, sludges and residues), will be contained within weatherproofed, sealed and bunded areas to ensure stability of the waste containment receptacles and prevent any leakages or spills causing environmental harm to soils, surface water or groundwater. Regular inspections will be carried out of the tanks, bunds and storage areas to ensure integrity.

The construction and operation of the project will not result in automatic listing of lots on the EMR or CLR providing that quantities of petroleum product or oil storage on any one lot does not exceed volume limits for above ground storage. These capacities are specified according to their chemical class and packaging codes as in Appendix 2 of the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (DERM 1998).

Should land contamination be encountered or occur as a result of the construction or operation of the project, appropriate procedures and measures will be put in place for the notification, mitigation, investigation, remediation, and validation of the contaminated land. The procedures will be documented in the project EMP and subsequent EMPs to be prepared by the construction contractor (refer **Chapter 5**).

The following provides an outline of the mitigation measures that will be undertaken during the construction phase of the project:

- Preparation of a Construction Occupational Health and Safety Plan (OH&S Plan) by the construction contractor which includes measures to manage exposure of construction workers to potential contaminants in soil and/or water; for example through the wearing of personal protective equipment and the control of dust during construction; and
- Preparation of a Contaminated Land Management Procedure prior to the commencement of construction which includes, but is not limited to:
  - identification of the likely forms of contamination that could occur during the project (fuels, oils, solvents etc);
  - procedures for appropriate storage of hazardous materials in compliance with relevant standards;
  - the prevention of land contamination during construction;
  - the identification, investigation and management of any acid sulphate soils in accordance with State Planning Policy 2/02 and Queensland Acid Sulphate Soil Technical Manual, Soil Management Guidelines;
  - spill response and remediation;
  - post construction management and/or monitoring requirements; and
  - as required, approval and disposal permits will be obtained from DERM for the removal of any contaminated soil in accordance with the EP Act.

4.2.2.4. Erosion and stability

The majority of the proposed pipeline traverses land that has a medium potential for erosion. Areas of high hillslope erosion potential (>10t/ha/yr) are identified in **Section 4.2.1.4** and generally correspond to steeper hilly sections of the proposed pipeline route including the Kerlong Range, Broadsound and Boomer Ranges and Sodosol areas. These areas have a high erosion risk which will lead to increased sedimentation into nearby areas.

Additionally the following processes have the potential to result in increased erosion levels:

- Mechanical dispersion of topsoils through machinery movement on topsoil and loss of organic matter from topsoil; and
- Long term exposure of bare soils.

Erosion potential and stability of the temporary workers' accommodation camps and the pipeline stockpile locations will be analysed during detailed geotechnical surveys to determine the suitability of the proposed locations and to determine detailed management measures. Topsoil and spoil stockpiles associated with the construction of the proposed pipeline route will be positioned upstream of drainage lines to minimise sediment loading of downstream waterways.

In general, erosion and sediment control measures will be incorporated into an Erosion and Sediment Control Plan and will include:

- Maintaining sediment control devices along drainage lines to prevent the transport of sediment from the site;
- Stockpiling materials (including topsoil) away from drainage lines to prevent the transport of sediment from site;
- Controlling drainage of camp sites, sewage effluent discharge areas, maintenance and storage areas (including hardstand areas and pipe stockpile locations) by surface drains and bunds;
- Suppressing dust during construction using a water truck;
- Managing traffic in construction zones in accordance with the TMP; and
- Rehabilitation of disturbed areas as soon as possible following disturbance.

Adequate monitoring and follow-up work during construction will also be undertaken to ensure any erosion issues are identified and addressed immediately. Progressive revegetation will occur as soon as practical after pipe laying and backfill to reduce potential erosion risk.

4.2.2.5. Landscape character

The proposed pipeline route will impact on landscape character where:

- The proposed pipeline route crosses a watercourse;
- The proposed pipeline route traverses an environmentally sensitive area; or
- The proposed pipeline route results in tree felling.

To minimise impacts on watercourses, the construction period around and across watercourses will be minimised. Most watercourses within the project area are ephemeral (apart from the Fitzroy River and parts of the Isaac River and Raglan Creek). Construction of the proposed pipeline route through watercourses should be scheduled outside the wet season where practical.

Where the proposed pipeline route is required to cross a high flowing water course e.g. the Fitzroy River, the pipeline will be under bored via HDD (subject to geotechnical investigation). This will also limit impacts on existing landscape character.

Areas of vegetation impacted from the construction of the proposed pipeline route will be appropriately rehabilitated once the pipeline is operational. The ROW will avoid sensitive vegetation where possible. Further, where the proposed pipeline results in the removal of protected vegetation, offset areas will be provided.

The project is not expected to impact on the broad-scale topography of the project area.

4.2.2.6. Visual amenity

Impacts on visual amenity are relatively subjective and depend on the sensitivity of the receiver. For the project, visual amenity impacts on sensitive receptors within 1 km either side of the proposed pipeline route have been identified as including residential dwellings, community purposes (one school, one ambulance station, one police station and one library) and roads.

The visual amenity impact of the project on nearby sensitive receptors will be minimal. The greatest visual amenity impacts generated from the project will be during construction where the impact is considered to be slight to moderate (refer **Table 4-10**).

Construction

During construction, the erection of temporary structures and key construction activities have the potential to impact on visual amenity.

Temporary structures will include five temporary workers' accommodation camps which will be located within 20 km of the proposed pipeline route at approximately 100 km intervals. The temporary workers' accommodation camps are expected to be located as follows:

- Camp 5 – Red Hill;
- Camp 4 – Daunia;
- Camp 3 – Hillcrest;
- Camp 2 – Foresthome; and
- Camp 1 – Bajool.

A number of laydown areas for pipe and equipment storage will also be provided in the ROW and at the temporary workers' accommodation camps. These lay down areas will be fenced and will be located away from any existing settlements.

Key activities during construction (as described in **Chapter 3**) that may impact the existing visual amenity of the area include:

- Clear and grade;
- Stringing and welding;
- Trenching;
- Lowering-in and backfilling;
- Crushing;
- Traffic; and
- Clean-up, restoration and rehabilitation.

The main visual impact to the existing environment from the project during construction will be the visibility of people, vehicles, plant and equipment, vehicle movements and stockpiles. Activities will be undertaken during the day and will have a limited duration at any one point in time. Construction will move from one area along the proposed pipeline route to another as the project progresses and therefore the total duration of any one construction activity at any location will not have high visual amenity impacts. Further, the additional level of traffic generated from the transportation of materials to and from the project site and the temporary workers' accommodation camps is not expected to have adverse impacts on the existing visual amenity of the project area.

Operation

Visual amenity impacts during operation will be limited. The buried pipeline will not be visible, however, above-ground infrastructure will be visible for the life of the project. Such infrastructure will include small fenced areas containing permanent above ground facilities including main line valves, scraper stations and a gas gathering station at the end of the line. Cathodic protection system posts and pipeline information markers are located along the alignment.

4.2.2.7. Lighting

Lighting impacts from the project are expected to be minimal. Most construction work associated with the project will be carried out during daylight hours and therefore no lighting will be required along the construction ROW.

Temporary workers' accommodation camps will be operated at night time, however, will be located away from towns and sensitive receptors within the project area and therefore will not impact on existing residents nor cause nuisance.

4.2.3. SUMMARY

The commitments that will be undertaken to mitigate potential impacts to land that have been identified in this section are listed in **Table 4-22**.

Table 4-22: Project commitments for land

Issue	Commitments
Land use suitability	Compensation is offered to the landowner for any temporary disruption to agricultural production during construction of the project.
	Construction of the project will be progressed sequentially, with clean-up, restoration and rehabilitation initiated, as soon as practical after backfilling is complete, while trenching and the other activities are advanced.
	Monitoring activities include post-construction audits to be conducted annually for two years to evaluate re-vegetation, erosion control, weed control, watercourse integrity and access of bed and bank re-profiling. Areas of high erodibility will be monitored more regularly.
	Any diesel or oil spills that may occur during construction activities will be contained within the construction location and managed in accordance with the EMP to prevent any impact on the surrounding environment.
	Normal cropping and grazing activities can be resumed over the pipeline easement following completion of construction and rehabilitation activities.

Issue	Commitments
Land disturbance	Where required, trench breaks will be installed prior to backfilling of the trench to control water movement along the backfilled trench. The location of trench breaks will depend on slope, soil type, hydrology and local conditions.
	The landscape will be rehabilitated to pre-existing contours with natural drainage lines restored and protected if required. In certain cases, rehabilitation will be tailored to site-specific conditions in consultation with the landholder.
	Monitoring activities include post-construction audits to be conducted annually for two years to evaluate revegetation, erosion control, weed control, watercourse integrity and success of bed and bank reprofiling. Areas of high erodibility will be monitored more regularly
	Detailed geotechnical investigations will be carried out to determine the geological risk of locating the proposed pipeline route in areas of faults, land slips, earthquakes and potential instability.
Erosion and stability	Erosion and sediment control measures will include: - Ensuring rehabilitated ROW landform is comparable with surrounding topography; and - Implementing and maintaining erosion and sediment control measures to prevent scour, particularly in areas of steep slopes.
	In areas of high hillslope erosion potential, stormwater diversion banks / drains (whoa-boys) will be placed diagonally across the rehabilitated ROW to divert stormwater to adjacent undisturbed grassed areas following completion of construction.
	Diversion drains will also be installed, where required, to divert stormwater away from the restored pipeline easement.
	Adequate monitoring and follow-up work during construction will also be undertaken to ensure any erosion issues are identified and appropriately addressed.
Land contamination	Chemical storage will comply with Australian Standards and Material Safety Data Sheets (MSDS) requirements and *Dangerous Goods Storage and Handling Guidelines 2010*.
	A Construction Operational Health and Safety Plan will be prepared which will include measures to manage exposure of construction workers to potential contaminants in soil or water.
	A Contaminated Land Management Procedure will be prepared prior to the commencement of construction.
Visual amenity	Temporary workers‘ accommodation camp sites to be located remote from nearby residences and communities where they will not be readily visible from populated areas or roads.

4.3. TRANSPORT

This section provides an assessment of transport infrastructure required for the project, any potential transport impacts during the construction and operational phases of the project as well as mitigation measures proposed to address these impacts.

This section has predominantly utilised the information provided in the *Traffic Impact Assessment* (TIA) prepared by GHD (2011) and included in **Appendix A4.5**, **Volume 3**. The TIA addresses the following:

- Traffic impacts associated with the construction of the pipeline on roadway traffic;
- Traffic impacts from road closures and temporary lane closures; and
- Identifies mitigation measures to address these impacts.

The report also identifies the number of vehicles required to transport construction plant and equipment, workforce trips, and the line pipe materials, and assesses whether there will be any significant impacts on State Controlled Roads (SCR), the local road and rail network and airports.

Legislation, policies and guidelines

The assessment of transport values associated with the project is based on relevant legislation, policies and guidelines, as summarised in **Table 4-23**.

Table 4-23: Legislation, policy and guidelines for transport

Legislation, policies and guidelines	Relevance
*Transport Infrastructure Act 1994 (*TI Act*) and Transport Infrastructure (State-controlled Roads) Regulation 2006*	▪ Regulates infrastructure (including roads and ports) throughout Queensland and encourages effective integrated planning and efficient management of transport infrastructure. ▪ Approval is required from DTMR and Queensland Rail to work on, interfere with, State owned roads and railways. ▪ Regulates traffic on SCR and specifies prohibited access to SCRs. ▪ Provides information on limiting encroachments and ancillary works which have not been declared. Refer to **Section 1.5.1**

Legislation, policies and guidelines	Relevance
*Transport Planning and Co-ordination Act 1994 (*TP&C Act*)*	▪ Regulates planning and coordination of transport and other matters for which the Minister is responsible. ▪ Aims to improve the economic, trade and regional development performance of Queensland and the quality of life of Queenslanders. Refer to **Section 1.5.1**
*Environmental Protection (Waste Management) Policy 2000 (*EPP(Waste)*)*	▪ Part 4 Schedule 1 of the EPP (Waste) addresses the transportation of designated waste as ‗trackable wastes'.
*Transport Co-ordination Plan for Queensland 2008-2018 (*TCP*)*	▪ Developed to improve a strategic framework for planning and management of transport resources. ▪ Intended to provide guidance to modal strategies and integrated Regional Transport Plans.
*Transport Operations (Road Use Management) Act 1995 (*TO Act*)*	▪ Regulates road management and provides for the effective management of road use in Queensland. ▪ Establishes a scheme to allow management of traffic to enhance safety and transport efficiency.
Integrated Transport Planning Framework	▪ Transport planning guidance in Queensland which set out a collaborative, consistent and sustainable approach to transport planning.

The requirement for any approvals for rail crossings or road crossings is addressed in **Appendix A2**, **Volume 3** of the EIS.

Methodology

The assessment of the existing transport infrastructure values undertaken within the TIA, and in relation to the proposed pipeline route and the project area, is based on:

- A desktop review of existing baseline conditions. This desktop study reviewed aerial photography and other available mapping information provided by Arrow to identify relevant access roads and transport infrastructure;
- A review of data provided by the DTMR on existing traffic counts for SCRs. This historical data was used to inform the study in terms of potential future growth of traffic along the main road networks; and
- An assessment of the potential transport-related impacts against the DTMR‘s *Guidelines for Assessment of Road Impacts of Development* (April, 2006) and adopted performance criteria.

The main performance criteria adopted for the assessment is detailed in **Table 4-24**.

Table 4-24: Performance criteria

Performance measure	Criteria adopted
Level of Service (LoS)	LoS C (stable flow) can be considered the minimum standard in a rural context, although LoS D (mostly stable flow, some delays) is considered satisfactory in circumstances involving event traffic (traffic associated with a unique event, e.g. sports event/festival).
Percentage increase in existing average annual daily traffic (AADT) on the SCR network.	Increases within 5% are generally considered acceptable.
Percentage increase on pavements	Increases within 5% are generally considered acceptable.

The scope of the TIA includes a number of limitations associated with the project assessment. The main limitations include:

- Lack of detailed information on road environment and pavement conditions for key routes;
- An assessment based on a series of assumptions to determine the likely traffic generation and distribution of traffic activity; and
- A visual inspection of key construction and haulage routes was not undertaken as part of this assessment.

4.3.1. DESCRIPTION OF EXISTING INFRASTRUCTURE AND VALUES

4.3.1.1. Existing road classifications

DTMR has jurisdiction over SCRs and has four administrative classifications in its hierarchy of roads:

- National Highway (NH);
- State Strategic Road (SSR);
- Regional Road (RR); and
- District Road (DR).

The classification of roads along the existing road network can be used as an indication of the functional role each road plays with respect to the appropriate volume of traffic it should carry in terms of both vehicle movements per day (vmpd) and vehicle movements per hour (vmph). DTMR has developed a set of road hierarchy classifications detailed in **Table 4-25**.

Table 4-25: Functional classification of roads

Type of Road		Traffic Volume (vmpd)	Peak Hour Volume (vmph)
Arterial Road	Highway	Volumes not restricted	>2,000
	Arterial	Volumes not restricted	
	Arterial Main	< 20,000	
Sub-Arterial Road	Traffic Distributor	Volumes not restricted	800 – 1,000
	Controlled Distributor	< 10,000	
	Sub Arterial Main	< 10,000	
Collector Road	Major Collector	< 6,000	300 – 600
	Minor Collector	< 3,000	
Local Road	Access Street	< 750	0 – 200
	Access Place	< 100	

The proposed pipeline route crosses several national, regional and district roads controlled by DTMR. These roads are listed in **Table 4-26** which also provides typical nominal volumes expressed in terms of average annual daily traffic (AADT) serviced by various classes of roads. Infrastructure crossings are shown on **Map series 8**, **Volume 2**.

Table 4-26: Key roads to be crossed and used for access

Road ID	Road name	Classification
10E	Bruce Highway (Benaraby-Rockhampton)	National Highway
41E	Burnett Highway (Biloela-Mount Morgan)	State Strategic Road
16A	Capricorn Highway (Rockhampton-Duaringa)	State Strategic Road
5101	Duaringa-Apis Creek Road	District Road
85C	Fitzroy Development Road (Dingo-Mt Flora)	Regional Road
33A	Peak Downs Road (Nebo-Mackay)	State Strategic Road
33A	Peak Downs (Clermonth to Nebo)	State Strategic Road
82A	Suttor Development Road (Nebo-Mt Coolan)	Regional Road

Apart from the pipeline crossing points with the key roads listed above, access to the ROW will be along these roads and sections of key roads listed in **Table 4-27**. Access roads are illustrated on **Map series 8**, **Volume 2**.

Table 4-27: Additional key road sections that will be used for access

Road ID	Road name	Classification
5307	Collinsville-Elphinstone Road	District Road
512	Marlborough-Sarina Road	District Road

4.3.1.2. Existing traffic volumes

The AADT (2009) volumes for SCRs and their respective heavy vehicle proportions are presented in **Table 4-28**.

Table 4-28: AADT volumes on SCR

Road ID	Road name	AADT	% heavy vehicle (HV)
41E	Burnett Highway (Biloela-Mount Morgan)	2,367	17.5%
16A	Capricorn Highway (Rockhampton-Duaringa)	-	-
5101	Duaringa-Apis Creek Road	-	-
85C	Fitzroy Development Road (Dingo-Mt Flora)	921	22.3%
33A	Peak Downs Road (Nebo-Mackay)	4,460	16.3%
33A	Peak Downs Road (Clermont-Nebo)	3,379	17.8%
82A	Suttor Development Road (Nebo-Mt Coolan)	876	19.2%
5307	Collinsville-Elphinstone Road	1,012	12.9%
512	Marlborough-Sarina Road	515	9.7%
10E	Bruce Highway (Benaraby-Rockhampton)	3,811	29.8%

4.3.1.3. Existing traffic volumes for local controlled roads

The respective local councils have responsibility for all other roads within the project area not listed above. A review of the local data provided by councils showed that the volumes recorded indicate very low traffic levels on local controlled roads. Most of the historical counts indicate fewer than 50 vehicles per day (vpd), with a small number of count sites registering up to 120 vpd. It is assumed that the majority of the local roads exhibit low traffic levels and can be used for access to the ROW for pipe deliveries, construction vehicles and personnel.

4.3.1.4. Road capacity for two-lane rural roads

Most access routes to the ROW are two-lane, two-way rural roads (one lane per direction), with the exception of road sections of the state highways that lead into the major urban centres. The AUSTROADS *Guide to Traffic Engineering Practice - Part 2: Roadway Capacity* defines level of service as a qualitative measure of operational conditions within a traffic stream. The LoS and its characteristics for rural roads are defined in **Table 4-29**.

Table 4-29: Level of Service (LoS) for rural roads

LoS	Description	AADT	Description
A	Free, unrestricted flow	1,100	Very good
B	Mostly free flow, few disruptions	2,800	Very good
C	Stable flow	5,200	Good
D	Mostly stable flow, some delays	8,000	Acceptable
E	Congested flow, delays common	14,800	Bad
F	Forced flow	n/a	Bad

Source: AUSTROADS Guide to Traffic Engineering Practice Part 2: Roadway Capacity

The volume and composition of traffic on a road determines the level of interaction between vehicles and is measured as its LoS. The LoS deteriorates with increasing traffic volumes. LoS A, LoS B and LoS C are regarded as satisfactory on rural roads. LoS D can be satisfactory in some circumstances.

The AUSTROADS Guide indicates that two-lane rural highways have a capacity of 2,800 passenger cars per hour total for both directions of flow (that is, 1,400 cars per hour in each direction) under ideal conditions where there are no restrictive roadway, terrain or traffic conditions.

In cases where traffic, terrain or geometric data is not precisely known, the AUSTROADS Guide provides planning guidance on maximum AADT values that two-lane, two-way rural roads can accommodate under various terrain conditions.

The values for various LoS (vpd) for two-lane, two-way rural roads on level terrain, with varying ratios of design hour volume to AADT is shown in **Table 4-30**.

Table 4-30: Maximum AADTs for various levels of service

Design Hour Volume to AADT Ratio	Level of Service (LoS)				
	A	B	C	D	E
0.10	2,400	4,800	7,900	13,500	22,900
0.11	2,200	4,400	7,200	12,200	20,800
0.12	2,000	4,000	6,600	11,200	19,000
0.13	1,900	3,700	6,100	10,400	17,600
0.14	1,700	3,400	5,700	9,600	16,300
0.15	1,600	3,200	5,300	9,000	15,200

Source: AUSTROADS Guide to Traffic Engineering Practice, Part 2: Roadway Capacity, Table 3.9, from TRB Highway Capacity Manual (1985) Table 8.10.

Based on a design hour volume to AADT ratio of 10%, **Table 4-30** indicates that the capacity of the main roads in the vicinity of the project area can theoretically achieve an AADT level of 4,800 vpd at LoS B, or 7,900 vpd at LoS C, and 13,500 vpd at LoS D.

In general, the acceptable LoS for rural roads is set at LoS C or a threshold value of 7,900 vpd. From **Table 4-28**, the existing AADT on the key state roads all fall below the threshold value of LoS C and hence, indicate that the key roadways are currently operating at acceptable levels of service and have sufficient spare capacity.

4.3.1.5. Construction traffic generation and distribution

It is anticipated that project construction will occur over a period of approximately 15 months with limited construction activity scheduled to occur over the ‗wet' season. The duration of construction activity at any location along the proposed pipeline route will depend on the terrain and other factors, but will be a number of weeks, rather than months.

Traffic volumes generated by construction personnel and by materials delivery will also vary, depending on the construction timetable.

Standard hours of work for the construction program are expected to be 6.00 am to 6.00 pm, seven days a week, on a 28-day-on, nine-day-off cycle. Construction activities do not normally commence earlier than 6.00 am.

Haulage of materials and plant will be a seven-day-per-week operation. Unloading the pipe line at the ROW will be limited to daylight hours, so the timing of the round trip for pipeline deliveries will depend on when trucks can be unloaded.

Construction vehicles and plant

Various plant and machinery will be necessary for construction of the proposed pipeline. Heavy vehicles likely to be required at the construction site are:

- Standard semi-trailers (if the line pipe is supplied in 12 m lengths or extendable tri-axle trailers (in the event that the line pipe is supplied in 18 m lengths) and where permissible, road trains, to transport line pipes to the site;
- Tipper trucks, to transport bedding sand on-site and excavated spoil off-site;
- Craneage to lift the pipe sections into position;
- Excavation machinery;
- Pipe-laying bulldozer (side-boom); and
- Equipment for directional drilling and horizontal boring.

The tipper trucks and the line pipe supply trucks are expected to travel along the SCR network. The crane(s), excavation equipment, pipe-laying bulldozer, drilling and boring machinery will be brought to site, and may also be stationary in areas where work is being undertaken and driven between sites along the ROW during construction.

Construction traffic

Traffic generated during the construction phase will mainly be from equipment and material deliveries, including:

- Movement of construction personnel and specialist supervisory personnel;
- Minor construction materials and consumables;
- Line pipe supply distribution; and
- Construction plant and equipment.

Construction camps and construction workforce

The construction workforce will consist of an estimated 693 workers who will be accommodated at the temporary workers' accommodation camps located close to the ROW.

Access to the temporary workers' accommodation camps will generally be by existing roads and tracks as well as the ROW.

The approximate locations of temporary workers' accommodation camps are:

- Camp 5 – Red Hill;
- Camp 4 – Daunia;
- Camp 3 – Hillcrest;
- Camp 2 – Foresthorne; and
- Camp 1 – Bajool.

The temporary workers' accommodation camps will be relocated along the proposed pipeline route in line with the construction phase. Two camp sites will be set up at the same time and will be located as close to the proposed pipeline route as possible to minimise road travel.

On completion of construction, the workforce will be demobilised and the temporary workers' accommodation camp sites rehabilitated.

The workforce is expected to leave the temporary workers' accommodation camp between the hours of 5.00 and 6.00 am to start their work and return between 5.00 and 6.00 pm. It is estimated that approximately 21 buses, 56 station wagons, 100 utilities and 14 twin cabs will be used for travel associated with staff movements from the temporary workers' accommodation camp sites to the ROW. Vehicles will travel on main roads to various access points to the ROW.

Light/medium vehicles will comprise 156 vehicles for staff movements from temporary workers' accommodation camps to the ROW. It is likely that the service vehicles will leave at various times of the day but travel will generally be confined within the ROW.

Minor construction materials and consumables

It is anticipated that approximately 20 vehicles will be used to service the project for deliveries of fuel, water, materials and other consumables to locations along the proposed pipeline route. These vehicles will use the local road network between the temporary workers' accommodation camps and the proposed pipeline route and will generally traverse the ROW.

Supervisory personnel

A total of 20 vehicles are expected to use the local road network to transport the supervisory workforce and other senior personnel. These vehicles will generally drive along the ROW when on site.

Construction Plant and Equipment

Construction plant and equipment will be delivered to the start point for construction with intermediate travel being along the ROW with the intent that they will be demobilised from the other end. There will be a minor amount of movement along roads where plant is moved to cross obstacles, such as watercourses and railways.

4.3.1.6. Line pipe supply delivery and distribution

The 580 km of line pipe will be delivered to Australia via Port of Mackay and the Port of Gladstone. It is estimated that a total of approximately 192,800 tonnes (t) of line pipe will be required, comprising of 185,000 t of DN1050, 4,500 t of DN500 and 3,300 t of DN400. This is anticipated to arrive at the ports every four weeks with approximately 20,000 t per ship.

The current line pipe logistics plan has been developed using the maximum pipline size expected (DN1050). The logistics plan will be refined once the final pipe diameter is confirmed. The number of vehicles and port entry will be reviewed at this time.

Line pipe delivery and distribution routes from Port of Mackay

Transport of 333 km of DN1050 line pipe (123,200 t), 50 km of DN500 (4,500 t) and 50 km of DN400 line pipe (3,300 t) will be from the Port of Mackay to a stockpile site in Nebo. This stockpile site provides surety of supply in the event of a severe weather incident in the northern section of the route.

Stockpile site at Nebo

Nebo has been identified as a suitable staging point for providing line pipe to the northern section of the proposed pipeline route. The stockpile site in Nebo will be utilised to store approximately 131,000 t, comprised mainly of DN1050 line pipe, but incorporating 4,800 t of DN500 and 3,300 t of DN400 line pipe for the laterals.

A breakdown of the anticipated truckloads and shipment details between Mackay and Nebo via Peak Downs Highway is provided in **Table 4-31**.

Table 4-31: Mackay to Nebo line pipe delivery details

Type	Mass (tonnes)	Delivery Period (days)	Trucks/Day	Mass/m (kg/m)	Truck Loads
DN1050	123,200	173	32	370	5536
DN500	4,500	26	8	90	208
DN400	3,300	26	6	66	106

It is anticipated that a total of 32 truck loads per day per direction (64 movements in both directions) will be required for the delivery of the DN1050 line pipe to the ROW. Distribution routes for the 42 inch diameter line pipe on the road network have been identified for both the main feeder roads and the local network. The number of delivery days will vary by road section utilised in the distribution route. The routes and number of delivery days are shown in **Table 4-32** and **Map 12**, **Volume 2**.

Table 4-32: Distribution routes and delivery period

Map legend	Route	Delivery period (days)	Remarks
	Port of Mackay to Nebo	173	All line pipe (123,200 t) to be transported to stockpile site in Nebo.
	Nebo to Glenden	33	23,700 t
	Nebo to Moranbah	17	11,800 t
	Nebo to Coppabella	17	11,800 t
	Nebo to Middlemount	61	43,400 t
	Nebo to Marlborough-Sarina Road	43	32,400 t

As presented in **Table 4-31**, it is anticipated that a total of eight vehicles per day per direction (16 movements for both directions) will be associated with delivery of the DN500 line pipe and six vehicles per day per direction (12 movements for both directions) will be associated with delivery of the DN400 line pipe. Distribution routes on the road network, for the DN500 and DN400 line pipe, have been identified for both the main feeder roads and the local network. The number of delivery days will vary per road section utilised in the distribution route. The routes and number of delivery days for each are shown in **Table 4-33** and **Map 13**, **Volume 2**.

Table 4-33: Distribution routes and delivery period

Map Legend	Route	Delivery period (days)	Total Weight
	Port of Mackay to Nebo	52	4,500 t of DN500 and 3,300 tonnes of DN400 line pipe to be transported to stockpile site in Nebo
	Nebo to Lake Elphinstone	13	2,300 t
	Nebo to Coppabella	13	2,300 t
	Nebo to Middlemount	26	3,200 t

Line pipe delivery and distribution from the Port of Gladstone

The remaining 167 km (61,800 t) of line pipe will arrive at the Port of Gladstone. Upon arrival of line pipe at Gladstone, delivery will be direct to the ROW for pipe stringing at the designated location.

To service the construction program, 32 truck loads per day will be required, producing 1,920 m per day and averaging three trucks per hour per direction or six trucks for both directions.

From the Port of Gladstone, line pipe will be delivered to Rockhampton via Mount Larcom along the Bruce Highway. Approximately 56 km (20,700 tonnes) of line pipe will be delivered to Rockhampton over a period of 29 days.

The remaining 111 km (41,100 t) of line pipe will be transported from the Port of Gladstone to Gracemere via Mount Larcom, along the Bruce Highway then along the Marlborough-Sarina Road, over a period of 58 days.

The routes and number of delivery days are shown in **Table 4-34** and **Map 14**, **Volume 2**.

Table 4-34: Distribution routes and delivery period from the Port of Gladstone

Map Legend	Route	Delivery Period (days)	Total Weight
	Port of Gladstone to Rockhampton	29	20,700 t
	Port of Gladstone to Gracemere	58	41,100 t

The use of the Port of Gladstone as a port of entry for line pipe will be considered depending on the availability of the port, shippling methods and the use of the port by other LNG proponents and existing users.

4.3.1.7. Road sectional usage on the SCRs due to line pipe delivery

The road sections along the routes identified in **Table 4-35** will be utilised for varying periods. **Table 4-35** indicates the approximate number of days that each section will be utilised for line pipe distribution. All sections will carry an average of 32 truck loads per day per direction or a total of 64 truck movements per day.

Table 4-35: Road sectional usage

Road ID	Road name	Road section	Usage (days)
33A	Peak Downs Road	Nebo-Mackay	225
33A	Peak Downs Road	Nebo-Clermont	184
5307	Collinsville-Elphinstone Road	Collinsville-Elphinstone	46
512	Marlborough-Sarina Road	Marlborough-Sarina Road	43
85C	Fitzroy Development Road	Dingo-Mt Flora	87
10E	Bruce Highway	Benaraby-Rockhampton	87

The line pipe will then be delivered to the ROW from the main feeder roads via the local road network. Consequently, a maximum of 32 trucks per day will also be using the local roads adjoining the proposed pipeline route.

An on-site inventory of road conditions and road limits along the haulage routes and key road links will be carried out in consultation with relevant authorities, prior to construction commencing.

4.3.1.8. Road, track and stock route crossings

Road (major and minor), track and stock route crossings relevant to the project area are identified in **Sections 3.4.1.1**, **3.4.1.2** and **3.4.1.3** respectively.

4.3.1.9. Railway crossings

A total of five railway lines will be crossed by the proposed pipeline route as identified in **Section 3.4.1.4**. The rail network from the Port of Gladstone is considered a feasible option to distribute line pipe. The decision as to whether to use rail has not been finalised. Since detailed cost modelling is yet to be undertaken, it has been assumed for the purpose of this assessment, that the road network will be utilised for transport representing a ‗worst-case' scenario.

4.3.1.10. Airports and airstrips

A number of airports and airstrips have been identified within 25 km of the proposed pipeline route, (refer **Section 3.4.1.5**). The largest airports identified within a 25 km buffer area of the proposed pipeline route include Rockhampton Airport, located approximately 10 km to the east and Moranbah Airport, located approximately 25 km to the west.

During the construction phase, the construction workers will be employed on a FIFO basis. At this stage it is not possible to determine which airports and airstrips will be used by the workers as the exact location of the temporary worker camps is yet to be determined.

4.3.1.11. Transportation of waste

The transportation of regulated wastes, as defined under Part 4 Schedule 1 of the EPP (Waste), is designated as ‗trackable wastes'. If wastes are considered trackable, then appropriate records of the waste must be passed on to the transporter. Trackable waste such as sludges produced during pigging operations may result in low level contaminated sludge (e.g. oil contaminated) in very low volumes. Any such waste will be disposed of by a licensed contractor at a licensed facility. The transportation of waste will be via the ROW, SCRs, and the local road network, as required.

4.3.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

The impacts of transport associated with the project include amenity, human health, safety and ecological values as a result of dust, noise and vibration.

Key off-site traffic issues mainly relate to:

- Use of identified road segments on the SCR network and local roads for access by heavy vehicles for delivery of line pipe, materials, equipment and machinery;
- Disruption to traffic due to road / lane closures brought about by construction activities at road crossings;
- Increase in travel time for other road users;
- Ability of the roads to handle the volume of construction traffic, particularly over-size and over-mass vehicles;
- Disruption to the rail network;
- Road and rail safety;
- Use of airports and airstrips;
- Transportation of waste; and
- Traffic management measures.

Existing data was obtained from DTMR who will be consulted as detailed design progresses.

4.3.2.1. Impacts of construction on access routes

Construction traffic on access routes will consist of light/medium and heavy vehicles. Light and medium vehicles will consist of personnel transport from the temporary worker accommodation sites and supervisory vehicles. Heavy vehicle traffic will consist of buses for transport of workers, line pipe supply deliveries, construction plant and equipment, and deliveries of construction materials, supplies and consumables.

The initial delivery of construction equipment to the site will occur in the early stages of the project. It is expected that intermediate travel will occur along the ROW and on occasional circumstances, on the local road network. These traffic movements are not expected to impact on the local road network since such movements can be confined to off-peak times.

In general, the movement of construction personnel traffic will be confined to local roads and the ROW and will not impact on the SCR network. It is anticipated that in some instances the use of state roads will be unavoidable and in these cases 100% of construction personnel traffic will be required to use the SCR network. However, when the use of the SCR network and local roads is required, this will normally be over short distances and for short times.

In the worst case scenario, when construction personnel traffic is required to use the SCR network, the additional daily traffic on the SCR will include 177 light vehicles and 21 buses transporting construction personnel, 32 truck loads for line pipe delivery and an additional 20 trucks for deliveries of construction supplies.

It should be noted that the locations of temporary workers' accommodation camps are only approximate, and the final placement of the camps will determine the exact impact on the road network. It is possible that the camps may be located such that no construction personnel traffic is required to travel on the SCR network in the course of routine construction activities.

Estimated total vehicle movements for the worst-case scenario are shown in **Table 4-36**.

Table 4-36: Estimated total vehicle movements on SCR (worse-case Scenario)

Vehicle	Heading	Daily (vehicles per day)
Heavy Delivery Traffic	Heavy vehicles for line pipe delivery	32
	Heavy vehicles for deliveries of fuel, water, materials and other consumables.	20
Construction Personnel Traffic	Light vehicles for construction personnel	156
	Buses for construction personnel	21
	Light vehicles for supervisory personnel	20
Total		**249**

The additional traffic movements on the key SCR and the anticipated LoS assuming the worst-case scenario is shown in **Table 4-37**. The additional traffic volume is unlikely to impact on existing road network operations as the network is expected to have spare capacity beyond this extra traffic.

Table 4-37: Impact of additional traffic movements on the SCRs

Road ID	Road name	Existing ADT	Existing LoS	Future AADT	Future LOS	Worse-case Traffic
33A	Peak Downs Road (Nebo-Mackay)	4,460	B	4,564	B	Pipeline delivery
33A	Peak Downs Road (Clemont –Nebo)	3,379	B	3,877	B	Pipeline delivery and construction personnel traffic
82A	Suttor Development Road (Nebo-Mt Coolan)	876	A	1,270	A	Construction personnel traffic
5307	Collinswood-Elphinstone Road	1,012	A	1,116	A	Pipeline delivery
512	Marlborough-Sarina Road	515	A	619	A	Pipeline delivery
85C	Fitzroy Development Road	921	A	1,025	A	Pipeline delivery
10E	Bruce Highway	3,811	B	4,309	B	Pipeline delivery and construction personnel traffic
41E	Burnett Highway	2367	B	2,761	B	Construction personnel traffic

4.3.2.2. Impacts on the SCR network

DTMR's *Guidelines for Assessment of Road Impacts for Development* (DTMR, 2006) stipulates that the extent of impact of the project on the SCR network can be assessed on the basis of percentage increase in existing AADT. It also states that where construction or operational traffic generated by the development equals or exceeds 5% of the existing AADT on the road section, traffic operation impacts need to be considered.

Since the bulk of additional traffic movements on the SCR network will be attributed to the delivery and distribution of line pipe, the additional traffic generated will be approximately 52 vehicles per day. It is assumed that traffic generated by movements of workers, construction materials and supervisory personnel will mainly be accessing the construction site through the local road network.

Use of the SCR network will not be regular and the additional traffic volumes will be minor.

The impact of this additional volume on state controlled roads is shown in **Table 4-38**.

Table 4-38: Construction traffic impact on SCRs

Road ID	Road Name	AADT	Future AADT	% Increase
33A	Peak Downs Road (Nebo-Mackay)	4,460	4,564	2.33%
33A	Peak Downs Road (Clermont-Nebo)	3,379	3,877	14.74%
82A	Suttor Development Road (Nebo-Mt Coolan)	876	1,270	44.98%
5307	Collinsville-Elphinestone Road	1,012	1,116	10.28%
512	Marlborough-Sarina Road	515	619	20.19%
85C	Fitzroy Development Road	921	1,025	11.29%
10E	Bruce Highway	3,811	4,309	13.07%
41E	Burnett Highway	2367	2,761	16.65%

As shown in **Table 4-38**, the additional traffic volume associated with the daily movement of service vehicles and the delivery of line pipe will exceed the threshold 5% increase in AADT. However, it is likely the service vehicles will not be travelling on the SCR network due to the proximity of the temporary workers' accommodation camps to the ROW.

This scenario assesses worst-case conditions where 100% of the service vehicle movements are assumed to be on the SCR network. Furthermore, it is also noted that this increase will be temporary and the number of days for which this volume will be exceeded has been determined. The expected increase in traffic on these roads is considered to be moderate in terms of overall congestion and roadway capacity.

4.3.2.3. Road crossings

The pipeline will cross road corridors at various points along the length of the proposed pipeline route. The crossing locations have been identified and are discussed in **Section 4.3.1.3**.

The method of pipeline construction to be applied at each crossing is yet to be determined. It is expected that most bitumen roads will be bored or HDD, where appropriate, and that most gravel roads will be open cut. However, this has not yet been clarified with either DTMR or the local councils responsible for those areas.

Generally, trenching is the preferred method of crossing because it is the most efficient. However, temporary road closures may be required and a Traffic Management Plan (TMP) will be developed in consultation with the relevant road authority prior to construction. In general, traffic will be restricted to one lane or around temporary diversion.

It is proposed that trenching be employed on roads carrying low traffic flows. It is expected that minimal delays would be experienced.

Where traffic volumes are anticipated to be high and road closures may cause unacceptable delays, other construction methods (such as thrust boring or another trenchless method) that cause less disruption may be employed.

4.3.2.4. Operational traffic impacts

When the pipeline is operational, occasional access along the pipeline easement will be required to conduct inspections and maintenance. Traffic volumes associated with these activities are expected to be negligible.

Where maintenance works coincide with road sections and safety requirements require the closure of road lanes, a TMP will be prepared in consultation with the relevant local government.

4.3.2.5. Public transport and school bus routes

Access routes for the project may overlap with school bus routes. As there are relatively low numbers of school bus services with each having a short time of operation within the day, it is expected that there would be negligible impact on the operation of the school bus routes. Potential impacts will be addressed in detail in the TMPs for the construction phase.

4.3.2.6. Impact on pavement

It is noted that a key road impact due to the additional traffic would relate to the potential deterioration of the road pavements due to the additional vehicle loads. An on-site inventory of road conditions along the haulage routes and key road links to access the ROW will be carried out in consultation with relevant authorities, prior to construction commencing.

A mitigation measure to be incorporated in the construction contract plan is to ensure that the vehicle loads for delivery scheduling adhere to specific load limits on the access routes to be used. Where necessary, reinstatement and repair of the road be immediately undertaken to ensure safe passage of vehicles and prevent further deterioration. It is anticipated that this short term duration would have minimal effect on the full life of the existing bitumen surfaced road pavements.

4.3.2.7. Impacts on road, track and stock route crossings

Crossings of sealed roads will be undertaken by thrust boring underneath the surface with limited impact on traffic flow as the roads will remain open and traffic will flow at all times. Minor crossings will be undertaken utilising open cut methods generally perpendicular to the road / stock route. Construction will be timed to minimise disruption to users and where required, side diversion tracks will be constructed or road plates used to minimise impacts to traffic flow. Traffic and safety management procedures will be implemented to ensure that users are aware of the activity and conditions are safe. There will be no permanent disruption to the stock route network.

4.3.2.8. Impacts on the rail network

Rail crossings will generally be undertaken by thrust boring or alternatively, HDD depending on geotechnical investigations. There will be no requirement to place a limit on the speed of trains during the construction works. Traffic and safety management procedures will be implemented during the construction work to ensure continued safety of all involved. While the rail network from the Port of Gladstone is considered a feasible option to distribute line pipe as described in **Section 4.3.1.9**, the decision whether to use rail has not been finalised.

4.3.2.9. Impacts on airports and airstrips

As discussed in **Section 3.4.1.5** it is not possible at this stage to determine which airports and airstrips will be used by the workers as the exact location of the temporary workers' accommodation camps is yet to be determined.

4.3.2.10. Impacts from the transportation of waste

The method and locations to be used for the transportation and disposal of wastes from the project area is addressed in **Section 4.4** of the EIS.

Waste management during construction, operation and decommissioning will be in accordance with all relevant regulatory requirements and commitments outlined in the EMP.

Chemical wastes e.g. oils and lubricants will be transported in suitable containers and appropriately labelled for safe transportation to an approved chemical waste depot or collection by a liquid waste treatment service.

Wastes generated at laydown areas will be segregated and stored in appropriate receptacles before transport for recycling or disposal by a licensed waste contractor in accordance with the Waste Management Plan (WMP) and the Environmental Management Plan (EMP).

4.3.2.11. Mitigation measures

The volume and intensity of truck movements will vary over the 15 month construction period depending on the stage of construction. Short term increases in traffic volumes on the road network and their duration have been determined. Based on the nominal capacity of the road network, the additional traffic due to the project can be adequately accommodated at acceptable levels of service, as long as the communities affected are kept informed of progress and safeguards implemented.

The delivery of materials and equipment will be spread over the construction period and the movement of these vehicles can be arranged to minimise impact on the local community.

Most of the construction activity will be confined to the project area and traffic movements within the ROW will be managed by the implementation of an appropriate TMP.

The TMP will be developed in consultation with the relevant DTMR regions, police and relevant local councils.

The TMP will address key safety and logistical issues that may arise due to:

- Project vehicles crossing major and minor roads;
- Safety risks brought about by increased heavy vehicle traffic;
- Lane closures; and
- The use of single-lane local access roads.

Mitigation measures will be developed to address each of these issues. Where necessary, separate site-specific local traffic management plans will be prepared in negotiation with the relevant local authority and/or DTMR, as appropriate.

Key off-site traffic issues will be addressed through the preparation and implementation of a comprehensive TMP.

A number of mitigation measures have been identified to ensure that transport and traffic impacts arising from pipeline construction and operation are minimised. These measures will be incorporated into the TMP.

An important mitigation measure relating to construction traffic impacts is the implementation of a community information and awareness program. This program will be initiated prior to construction starting and continue through the construction period to ensure that local residents are fully aware of construction activities, with particular regard to traffic issues.

The awareness program will identify communication protocols for community feedback on issues relating to construction vehicle driver behaviour and construction-related matters.

Other initiatives to be undertaken as part of the TMP will include:

- Requirement to consult with the DTMR to identify mitigation measures to address the relative increase in traffic levels (>5% or a percentage value to be nominated by the DTMR) on affected road sections of the SCR network;
- General signposting of access roads with appropriate heavy vehicle and construction warning signs;
- Review of speed restrictions along SCR network and where necessary, additional signposting of speed limitations;
- Installation of specific warning signs at local access roads within the project area to warn existing road users of entering and exiting traffic;
- Distribution of day warning notices to advise local road users of scheduled construction activities;
- Advance notice of road/lane closures and advice on alternative routes;
- Installation of appropriate traffic control and warning signs for areas identified where potential safety risk issues exist;
- Manage the transportation of construction materials to maximise vehicle loads to therefore minimise vehicle movements;
- Whenever practical vehicles associated with the construction works should use internal and haulage access roads instead of public roads;
- Induction of truck and vehicle operators on the requirements of the TMP; and
- Implementation of a community information and awareness program to be initiated prior to construction commencing and continue throughout the entire construction period to ensure that local residents are fully aware of the construction activities, with particular regard to construction traffic issues.

An on-site inventory of road conditions along the haulage routes and key road links to access the project area and ROW will be carried out in consultation with relevant authorities prior to construction commencing.

A mitigation measure to be incorporated in the TMP will be to ensure that the vehicle loads for delivery scheduling adhere to specific load limits on the access routes to be used.

Environmental impacts are addressed in the relevant sections of the EIS as appropriate to the project with mitigation measures included in the EMP (refer to **Chapter 5**).

4.3.3. SUMMARY

The assessment of road transport impacts has identified that:

- Construction traffic will create short term increases in traffic volumes on the road network during the construction period of 15 months;
- The worse-case increase in traffic on key SCRs from the construction of the pipeline is considered moderate in terms of congestion and roadway capacity;
- The key SCRs have sufficient spare roadway capacity to accommodate the expected traffic increases during the construction period and will operate at acceptable levels of service (i.e. LOS C or better);
- The delivery of materials and equipment will be spread over the construction period of 15 months and the movement of these vehicles can be arranged to minimise impacts on the local community;
- Construction activity will primarily be confined within the ROW, and traffic movements will be managed by appropriate traffic control plans for work sites;
- The operation of the pipeline will not generate additional traffic except for inspection and maintenance vehicles, the incidence of which will be negligible; and
- The current road network has been identified to be suitable for the proposed vehicle movements without the need for major improvements to pavement condition, carriageway alignment and road width based on this desktop assessment.

A TMP will be developed in conjunction with the DTMR, QPS and local councils to address and mitigate the road transport impacts identified.

The rail network has been identified as a potential means of distributing line pipe from Port Mackay, although this is yet to be decided. The construction phase will not utilise the existing rail network as a means of transporting construction personnel. Traffic and safety management procedures will be implemented during the construction work during the crossing of the rail network to ensure continued safety of all involved.

The use of airports and airstrips by the FIFO construction workforce will be determined when the exact location of the temporary workers‘ accommodation camps is identified.

Wastes will be consolidated in applicable waste streams and transported from each of the areas for recycling or disposal by a licensed waste contractor in accordance with the WMP and the EMP.

The transport commitments relating to the project are summarised in **Table 4-39**.

Table 4-39: Commitments for transport

Issue	Commitment
Transport	A TMP will be developed in conjunction with DTMR, QPS and local government to address key safety and logistical issues that may arise due to: ▪ Project vehicles crossing major and minor roads; ▪ Safety risks brought about by increased heavy vehicle traffic; ▪ Lane closures; and ▪ The use of single-lane local access roads.
	Trenching will be used to cross most minor roads, with thrust boring likely to be used at busy roads to avoid traffic disruption.
	Railways will be crossed using directional drilling or thrust boring techniques.
	The vehicle loads for delivery scheduling will adhere to specific load limits on the access routes to be used.
Transport of waste	Refer to **Section 4.4**.
Road transport access route	Undertake a road assessment that provides a road condition report and assesses its predicted ability to withstand the heavy short term usage it will be subjected to for the line pipe distribution.

4.4. WASTE

This section provides technical details of waste treatments and minimisation associated with the project, with regard to proposed emission, discharge and disposal criteria.

The waste management information within this section informs the EMP for the project (refer to **Chapter 5**).

Legislation, policies and guidelines

The waste management requirements of the project are based on relevant legislation, policies and guidelines as summarised in **Table 4-40**.

Table 4-40: Legislation, policies and guidelines for waste

Legislation, policies and guidelines	Relevance
Environmental Protection Act 1994 and *Environmental Protection (Waste Management) Regulation 2000*	▪ Clarifies waste management practices in Queensland and provide improved environmental safeguards aimed at reducing waste and ensuring waste is managed so that it doesn't cause health or environmental problems.
Environmental Protection (Waste Management) Policy 2000 (EPP(Waste))	▪ Provides a strategic framework for managing waste in Queensland by establishing principles for achieving good waste management and a preferred waste management hierarchy.

Legislation, policies and guidelines	Relevance
Environmental Protection (Air) Policy 2008 (EPP (Air))	▪ Identifies the environmental values of the air environment to be enhanced or protected and to achieve the object of the EP Act. The Policy also specifies air quality guidelines and objectives.
Queensland's Waste Reduction and Recycling Strategy 2010-2020	▪ A 10-year plan to achieve the government's vision of a low-waste Queensland and is underpinned by the waste and resource management hierarchy.
Central Queensland Waste Management Strategy	▪ Develops methods to reduce quantity of waste to landfill as well as resource recovery and better management of solid waste.

Methodology

The assessment of the potential waste streams generated during construction and operation of the project is predominantly based on:

- A review of relevant legislation, policies and guidelines;
- A review of the activities and methodology during all phases of the project;
- A review of the environmental values associated with the generation of waste; and
- An assessment of the potential waste related environmental impacts, waste streams and mitigation measures.

4.4.1. DESCRIPTION OF ENVIRONMENTAL VALUES

Waste will be generated throughout all phases of the project, including construction, operation and decommissioning.

The waste generated during the project will include air emissions, excavated waste, solid and liquid waste.

The largest quantities of waste will occur during the construction of the proposed pipeline. Construction waste will be generated along the ROW, at laydown areas within the ROW and at temporary workers' accommodation camps. All construction sites along the proposed pipeline route will have similar types and volumes of construction wastes due to the standard construction methodologies as outlined in **Chapter 3** of the EIS. The largest volumes of waste will be during the establishment and re-establishment of the temporary workers' accommodation camps in the form of solid waste, and during HDD from the drill string.

Small amounts of waste will be produced during operation and maintenance in the form of liquid waste from the pigging and pipe cleaning activities. It is predicted that small volumes of scrap metal will be generated when the proposed pipeline is eventually decommissioned.

The waste items, volumes and existing environmental values which will potentially be impacted by the generation of waste are described in **Table 4-41**. The table also identifies the section of the EIS which addresses the impacts on the existing environmental values along the proposed pipeline route.

Table 4-41: Waste items, volumes and environmental values

Waste item	Volume	Environmental Values	EIS section
Construction Waste			
Excavated waste			
Excess spoil removed from the trench	▪ Minimal - generally returned to the trench as backfill after treatment with a padding machine	▪ Land use ▪ Ecology	▪ Section 4.2 ▪ Section 4.8
Air emissions			
Excess dust during the excavation of the trench	▪ Minimal – generally windblown dust.	▪ Air quality ▪ Social ▪ Health and Safety ▪ Hazard and Risk	▪ Section 4.6 ▪ Section 4.10; ▪ Section 4.11; and ▪ Section 4.13.
Solid Waste			
Packaging, recyclable and reusable wastes including timber skids, pallets, drums, scrap metals and fibre/nylon ropes and drums.	▪ 4 x 12 m^3 skips for initial camp site establishment assuming new units ▪ 4 x 12 m^3 skips for re-established subsequent camp sites per 28-day cycle ▪ All pipe-delivery packaging (e.g. ropes, straps) will be removed from the ROW daily	▪ Land use ▪ Ecology ▪ Social ▪ Health and Safety ▪ Hazard and Risk	▪ Section 4.2 ▪ Section 4.8 ▪ Section 4.10; ▪ Section 4.11; and ▪ Section 4.13.
Scrap – welding rods (stub ends) / grinding discs	▪ 5.5 m^3 skip per week		
HDD cuttings / tailings (no additives other than bentonite)	▪ 200 m^3 per 400 m drill string		
Camp site wastes – putrescibles, paper, timber & plastic piping	▪ 12 m^3 per 28-day cycle ▪ 3 x 4 m^3 skips with lids (paper / glass, cans /		

Waste item	Volume	Environmental Values	EIS section
	putrescibles)		
Cleared vegetation (felled timber)	▪ Minimal		
Liquid Waste			
Used chemicals and oils – e.g. lube oil, spent x-ray film developer chemicals (if automatic ultrasonic inspection system not used), used tins from solvents	▪ 200 L drums (or similar sealed container)	▪ Land use ▪ Ecology ▪ Social ▪ Health and Safety ▪ Hazard and Risk	▪ Section 4.2 ▪ Section 4.8 ▪ Section 4.10; ▪ Section 4.11; and ▪ Section 4.13.
Sewage from campsites.	▪ 75 kL/day		
Commissioning Waste			
Liquid Waste			
Hydrotest water (first flush ‗slug‘)	▪ 1 ML/25 km long test section	▪ Land use ▪ Ecology ▪ Social ▪ Health and Safety; ▪ Hazard and Risk.	▪ Section 4.2 ▪ Section 4.8 ▪ Section 4.10; ▪ Section 4.11; and ▪ Section 4.13.
Hydrotest water	▪ up to 25 ML/25 km long test section		
Cleaning and drying pigs	▪ As required		
Operational wastes			
Liquid Waste			
Sludge (pigging)	▪ Small	▪ Land use ▪ Ecology ▪ Social ▪ Health and Safety; ▪ Hazard and Risk.	▪ Section 4.2 ▪ Section 4.8 ▪ Section 4.10; ▪ Section 4.11; and ▪ Section 4.13.
Decommissioning wastes			
Solid waste			
Scrap metal	▪ 2 x 12 m shipping containers per scraper station	▪ Soils ▪ Ecology ▪ Social ▪ Health and Safety; ▪ Hazard and Risk.	▪ Section 4.2 ▪ Section 4.8 ▪ Section 4.10; ▪ Section 4.11; and ▪ Section 4.13.

4.4.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

This section identifies the potential impacts associated with the waste generated from the construction, operation and decommissioning of the project and describes the preferred mitigation methods and waste management strategies to deal with the associated waste.

4.4.2.1. Waste generation

Construction wastes

The waste generated during the construction phase has the potential to impact on the environmental values identified in **Section 4.4.2** if the waste is not controlled, stored and disposed of in the correct manner.

The potential impacts associated the unregulated/uncontrolled storage and disposal of waste includes:

- Potential nuisance to local residences from dust deposition during the excavation of the trench, the storage and treatment of spoil and topsoil and the movement of vehicles and equipment along the ROW and road network;
- Potential contamination of existing land-uses and soil resulting in a loss or deterioration of GQAL and SCL;
- Potential contamination of existing water resources and water quality from the accidental spillage or leakage of hazardous chemicals and substances;
- Potential contamination of protected ecosystems and habitats resulting in their deterioration or loss; and
- Potential impacts on the community‘s health and safety and quality of life from the loss or deterioration of the recreational and visual amenity and the landscape character of the project area.

Where practical, wastes will be segregated and consolidated in applicable waste streams and transported from the project area for recycling or disposal by a licensed waste contractor in accordance with the Waste Management Plan (WMP) described in **Section 4.4.2.2**.

The project workforce will be made aware of the WMP and EMP through project inductions and tool box discussions and will be required to comply with these plans at all times. Where feasible and approved by the landholder, vegetation wastes (felled timber) created though clearing activities will be positioned in small piles along the edge of the ROW to provide habitat for fauna species. Any declared plants will be eradicated and disposed of in accordance with EMP

Designated areas and /or storage containers will be clearly labelled and allocated for each waste stream to:

- Provide simple options for waste disposal;
- Eliminate the potential for any release of contaminants to the surrounding environment; and
- Minimise the potential for litter on site.

Reusable and recyclable wastes (timber, skids, pallets, drums, scrap metals and circumferential fibre /nylon rope spacers used in pipe transport, shall be stocked piled for recycling.

All pipeline delivery packaging (e.g. ropes, straps) will be removed from the ROW and disposed of to an authorised facility by a licensed waste contractor in accordance with waste management guidelines and the procedures outlines in the WMP. Licensed waste disposal facilities within reasonable distance of the project area will be identified and used for disposal of putrescibles and non-putrescibles solid wastes generated by the project.

General refuse shall be collected and transported to a Local Government approved disposal site. Wastes will be appropriately contained and /or covered to prevent access by stock or wildlife and lidded refuse containers will be located at each worksite.

Excavated material will be returned to the trench as backfill. This may require crushing or treatment with a padding machine. Any excess spoil not able to be returned to the trench (e.g. rock that cannot be suitably crushed) will be disposed at a site as agreed with the landholder.

Any spillage of hazardous waste or other contaminants that may cause environmental harm will be effectively contained and cleaned as quickly as possible to reduce the likelihood of release to any soil or water resources.

Chemical wastes e.g. oils, solvents and lubricants will be collected in 200 litre drums (or similar sealed containers) and appropriately labelled for safe transportation to an approved chemical waste depot or collection by a liquid waste treatment service.

All binding material and dunnage from transport vehicles and unloading areas is to be collected and transported off the ROW to designated disposal areas.

Temporary workers‘ accommodation camps will be short term facilities located away from watercourses and sensitive environments (such as remnant vegetation areas). A packaged STP with sufficient capacity will be installed at each temporary workers‘ accommodation camp. Each packaged treatment plant will produce treated grey-water (wastewater) of appropriate quality for land irrigation and regular monitoring of the treated wastewater will be undertaken to confirm this. Irrigation locations for treated wastewater will be selected to ensure:

- That there is no discharge directly to any watercourse;
- They are located away from areas used by humans;
- That they are fenced to prevent livestock entry; and
- Are signposted to advise that effluent is being irrigated.

With the appropriate treatment of wastewater and irrigation onto suitable land away from water courses, the impacts of the disposal of treated wastewater from the temporary workers' accommodation camps will be negligible. Arrow will liaise with local councils along the proposed pipeline route (as part of the separate development application process for the temporary workers' accommodation camp) to ensure that sites chosen for irrigation of treated wastewater are suitable for the purpose.

Food wastes from the temporary workers' accommodation camps will be kept covered before collection to prevent the introduction / attraction of vermin and flies.

There will be several laydown areas located along the ROW. These areas will be used to store vehicles and equipment as well as temporary site offices, administration facilities and meeting points for construction crews. Additional wastes generated at these areas are likely to include general administration waste such as paper/cardboard and printer toners. There may also be additional construction wastes such as pipe cut-offs, spacers and skids. Wastes generated at laydown areas will be segregated and stored in appropriate receptacles before transport for recycling or disposal by a licensed waste contractor in accordance with the WMP and the EMP.

The potential impacts associated with the release of hydrotest water and the cleaning and pigging activity during commissioning, includes the contamination of soils resulting in the loss or deterioration in land use, the contamination of water resources and water quality and the deterioration and loss of protected ecosystems and habitats.

During construction of the proposed pipeline, the integrity of the pipeline will be verified by undertaking hydrostatic testing (refer **Section 3.2.3.10**). The volume of water used to hydrostatically pressure test has been calculated as up to 25 ML per 25 km length of pipeline. Approximately 1 ML of this water will be discharged at the end of each test section (approximately every 25 km) after use as a first flush ‗slug'. The remaining volume will be re-used for multiple test sections where practical. Discharge or recycling of test water for secondary uses, such as pasture irrigation, will be undertaken only where water quality is within relevant statutory water quality guidelines.

Operational wastes

During operation of the pipeline, it is possible that regulated waste such as low volume, low level contaminated soil / gravel (e.g. oil contaminated etc) may be generated from contact with sludges from pigging operations. This may result in the contamination of soils, water resources and water quality and ecosystems.

While this waste can be disposed of at licensed facilities, in situ bio-remediation can also be undertaken. Any disposal of regulated wastes will be undertaken by a licensed contractor at a licensed facility.

Decommissioning

The management of wastes during decommissioning of the pipeline will be undertaken in accordance with accepted legislative guidelines and industry codes and practices relevant at the time. At the time of decommissioning, a decision will be made regarding any future uses for the pipeline.

4.4.2.2. Waste management

The transportation of regulated wastes as defined under Part 4 Schedule 1 of the EPP (Waste) is designated as ‗trackable wastes'. If wastes are considered trackable, then appropriate records of the waste must be passed on to the transporter. Trackable waste such as sludges produced during pigging operations may result in low level contaminated soil / gravel (e.g. oil contaminated) in very low volumes. Any such waste will be disposed of by a licensed contractor at a licensed facility.

The construction, commissioning and operation will be carried out in accordance with the WMP and the relevant EMP for the project. The aim of these plans will be to minimise waste generation and maximise reuse and recycling of waste products.

The key principles of waste management for the project will be based on the following waste management hierarchy:

- Waste avoidance;
- Waste re-use;
- Waste recycling; and
- Waste disposal.

The WMP will provide a framework for waste management for the project and will describe and deal with the following issues:

- The types and amounts of waste generated during the construction, commissioning and operation of the pipeline;

- How each waste will be dealt with, including a description of the types and amounts of waste that will be dealt with under each of the waste management practices mentioned in the waste management hierarchy (section 10 of the EPP(Waste));
- Management procedures to deal with accidents, spills and other incidents;
- Information on the frequency of the audits to assess the performance of the waste management practices; and
- Details of the indicator/ criteria on which the performance of the waste management practices will be assessed.

The strategies outlined in the WMP will be monitored during regular inspections, audits and reviews to ensure a clean and waste-efficient construction site, amount of waste recycled, no litter left on site during construction and no non conformance reports issued in relation to waste management. The WMP also includes corrective action if indicators aren't achieved.

Waste Management Plan

A project specific WMP will be produced with the aim of guiding the effective and responsible waste management of the project through relevant project commitments and legislation (e.g. the EP Act). The WMP will provide a framework for onsite waste management through developing strategies, monitoring performance, setting targets and implementing action plans for improvement.

The development of the WMP is iterative and the plan will be updated and refined as the details of the project are finalised.

4.4.3. SUMMARY

The storage and disposal of waste generated during the construction, operation and decommissioning of the project is unlikely to have significant impacts on the community health and safety values and quality of life, ecosystems and habitats, land-use and soil, the quality of water and the recreational and visual amenity of the project area and immediate surrounding area, with the implementation of appropriate waste management measures.

Waste management will be an integral component of all phases of the project, particularly during construction. A WMP will be prepared prior to the commencement of the construction in accordance with the EPP (Waste) and all applicable legislative requirements.

Construction-related wastes will constitute the greatest volumes of waste for the life of the project. Wastes will be consolidated in applicable waste streams and transported from each of these areas for recycling or disposal by a licensed waste contractor in accordance with the WMP and the EMP.

The Project waste management commitments relating to the construction, commissioning and operation of the project are summarised in **Table 4-42**.

Table 4-42: Project commitments for waste management

Issue	Commitment
Community's health and safety and quality of life, ecosystems and habitats, water quality and land use.	▪ A WMP will be prepared prior to the start of the construction of the pipeline in accordance with the EPP (Waste Management) and all applicable legislative requirements. ▪ Waste management will be based on the waste hierarchy - waste avoidance, waste re-use, waste recycling, and waste disposal. ▪ Waste management will be in accordance with all relevant regulatory requirements. ▪ All pipeline packaging waste material (e.g. ropes and straps) will be removed from the ROW and disposed in accordance with local government requirements. ▪ Reusable and recyclable wastes, such as timber skids, pallets, drums, scrap metals and circumferential fibre/nylon to spacers used in pipe transport shall be collected and stockpiled for recycling. ▪ All binding material and dunnage from transport vehicles and unloading areas is to be collected and transported off the ROW to designated disposal areas. ▪ General refuse shall be collected and transported to a Local Government approved disposal site. ▪ Lidded refuse containers will be located at each worksite. ▪ Construction workers will be made aware of the WMP through the inductions process and tool box talks.
Community's health and safety and quality of life.	▪ Any vegetation wastes created though clearing activities will be either chipped for re-use or stockpiled and used as windrows along the ROW or left for use by the landholder. ▪ Declared plants detected on the ROW will be eradicated and disposed of (e.g. sprayed and disposed of to a regulated landfill) according to relevant legislative requirements.
Community's health and safety and quality of life.	▪ Licensed waste disposal facilities will be identified and used for disposal of putrescibles and non-putrescibles solid wastes.
Soil, land use and the community's health and safety and quality of life.	▪ All suitable material extracted during trenching will be re-used in the trench as padding and backfill for the pipeline. ▪ Drilling mud will be screened and recycled if practicable or buried in the proposed pipeline trench or pit within the ROW.
Water quality and water resources and land use.	▪ Waste oil and solvents shall be collected by approved contractors for recycling, re-use or disposal at approved locations. ▪ Chemical wastes will be appropriately labelled and contained in sealed containers for safe transport to an approved chemical waste receivable/disposal depot or collection by a liquid waste treatment service. ▪ Any spills will be effectively contained and cleaned as quickly as possible.
Water quality and land use.	▪ A packaged STP will be installed at temporary workers' accommodation camps and the treated grey water irrigated in accordance with the relevant approval conditions.
Water quality and land use.	▪ Discharge or recycling of hydrostatic test water for secondary uses, such as pasture irrigation, will be undertaken in accordance with relevant water quality guidelines.

4.5. WATER

This section describes the existing environmental values of the surface water catchments, watercourses, drainage pathways, wetlands and sources of water supply within the project area that may be affected by the project. It identifies and discusses the legislative context and practical measures for protecting or enhancing surface water environmental values.

Legislative context and standards

The assessment of water values associated with the project is based on key legislation, policies and guidelines outlined in **Table 4-8**.

Table 4-43: Legislation, policy and guidelines for water

Legislation, policy and guidelines	Relevance
Surface Water	
Environmental Protection Act 1994 (EP Act)	▪ The principal legislative basis for water quality management in Queensland. ▪ Outlines the process for determining which water quality guidelines to use in water quality planning and decision making. ▪ Aims to achieve development that is ecologically sustainable through: identifying environmental values for Queensland waters (aquatic ecosystems, water for drinking, water supply, water for agriculture, industry and recreational use); and deciding and stating water quality guidelines and objectives to enhance or protect the environmental values. ▪ The development of local water quality guidelines has been proposed under the EPP (Water) through the release of a consultation paper (DERM, 2010).
Environmental Protection (Water) Policy 2009 (EPP(Water))	
Water Act 2000 (Water Act)	▪ The principal act for the management of water resources in Queensland. Water resource plans are subordinate plans to this legislation. Refer to **Section 1.5.1.2**.
Water Resource (Burdekin Basin) Plan 2007 and associated Resource Operations Plan (ROP)	▪ The proposed pipeline route crosses three Water Resource Plans (WRPs) areas including Burdekin, 2007; Fitzroy, 1999 and Calliope River, 2006; ▪ Identifies the allocation and sustainable management of surface waters that have been developed pursuant to the Water Act for the resources in the regional area of the project site; and ▪ The purpose of WRPs is to outline the availability of water in a catchment and define the framework for managing the allocations and use of water resources.
Water Resource (Fitzroy Basin) Plan 1999 and associated ROP The WRP is currently under revision. A draft WRP for the Fitzroy Basin was released for public consultation on 14 December 2010 but is yet to be finalised.	
Water Resource (Calliope River Basin) Plan 2006 and associated ROP	

Legislation, policy and guidelines	Relevance
Code of Environmental Practice – Onshore Pipelines (APIA CoEP, 2009)	▪ Provides minimum environmental management standards for pipeline construction, operation and decommissioning. This code guides the use of appropriate techniques for pipeline installation, maintenance and decommissioning phases.
Establishing Environmental Values, Water Quality Guidelines and Water Quality Objectives for Fitzroy Basin Waters – Draft for Consultation (DERM, 2010).	▪ Draft report addressing the development of environmental values and water quality objectives for the waters of the Fitzroy Basin in accordance with the provisions of Schedule 1 of the EPP (Water).
Guideline - Establishing Draft Environmental Values, Management Goals and Water Quality Objectives (DERM, 2011)	▪ Informs the establishment of draft environmental values, management goals and draft water quality objectives for Queensland waters under Part 4 of the EPP (Water).
Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC & ARMCANZ, 2000)	▪ Prepared as part of Australia's National Water Quality Management Strategy (NWQMS). The NWQMS aims to achieve the sustainable use of Australia and New Zealand's water resources by protecting and enhancing their quality while maintaining economic and social development. These national guidelines provide a framework for assessing water quality through comparison with guidelines derived from local reference values.
Queensland Water Quality Guidelines 2009 (QWQG) (DERM, 2009)	▪ DERM developed QWQG (EPA 2009) to include locally and regionally relevant water quality data for fresh, estuarine and marine waters. Where the QWQG provide water quality guideline values for Queensland waters that are more localised than the ANZECC 2000 guidelines, the QWQG take precedence over the (broader) ANZECC 2000 guidelines.

Methodology

The assessment of various surface water and water quality parameters within the project area is based on:

- *Water Crossing Information for Arrow Bowen Gas Pipeline* (AECOM 2011) which identified a range of watercourse values within the project area (**Appendix A4.12**, **Volume 3**);
- Water Availability Study (GHD 2011) (**Appendix A4.9**, **Volume 3**).
- Water quality field surveys undertaken during September, 2011. Water quality was measured in-situ at each of the freshwater sites using a YSI Pro Plus and a HACH 2100Q Turbidity Meter. A range of parameters were measured including dissolved oxygen (DO), pH, conductivity (µS/cm – mS/cm), turbidity (NTU) and temperature

(°C). The water quality meter was calibrated prior to fieldwork being undertaken. A summary of in-situ water quality data collected during the site surveys is presented in **Appendix A4.13**, **Volume 3**;

- A review of ESA mapping and referable wetland mapping (DERM, 2009) was undertaken to determine the classification, extent and significance of wetlands within the project area. Wetland characteristics were also recorded during site surveys between 14 June to 4 July and 29 August to 11 September, 2011 (**Appendix A4.3**, **Volume 3**); and
- *Flood Impact Assessment Study* (GHD 2011) (**Appendix A4.14**, **Volume 3**). A total of 11 watercourses along the proposed pipeline route were assessed for flood impacts.

Hydrologic calculations were undertaken to estimate the 100 year ARI peak catchment discharges at the flood prone locations for input to hydraulic calculations of flood levels. The following methods were used:

- DTMR regional flood estimation method was applied to the catchments devoid of any stream gauging data;
- Flood frequency analysis was used in preference to the DTMR method for catchments that have available stream gauging data; and
- 1-D HEC-RAS models were used to estimate the flood levels at 11 flood prone locations. These models incorporated information from the stream gauge data (where available) and available topography data.

The extent of the proposed pipeline route that will be potentially inundated by the 100 year Average Recurrence Interval (ARI) flood event was then determined by superimposing the estimated flood levels onto a representation of the land surface derived from the available topographic data.

HEC-RAS modelling was not undertaken for locations where the topographic data was insufficient. At these locations the flood inundation extent was estimated directly from the topographic survey data.

4.5.1. DESCRIPTION OF ENVIRONMENTAL VALUES

The proposed pipeline route will cross a number of perennial, seasonal and intermittent watercourses including rivers, streams, floodplains and wetlands as shown on **Map series 8**, **Volume 2**.

The proposed pipeline route traverses three river basins including the Burdekin, Fitzroy and Calliope River basins with the majority of the proposed pipeline route being contained within the Fitzroy Basin (refer to **Table 4-44** and **Map 15**, **Volume 2**). The Fitzroy Basin is the largest basin in Queensland and drains via the Fitzroy River to the eastern seaboard through the city of Rockhampton in Central Queensland.

Table 4-44: River basins crossed by the project site

Project location	River basin
AB0 to AB39	Burdekin
AB39 to AB469 EL0 to EL52 SL0 to SL25.8 DL0 to DL25.7	Fitzroy
AB469 to AB478	Calliope River

From the Burdekin Basin, the AB mainline crosses Suttor Creek before crossing into the Fitzroy Basin. Here, the AB mainline crosses three major river catchments, namely the Mackenzie, Isaac and Fitzroy. From the Fitzroy Basin (where all three laterals are located) the AB mainline extends 9 km within the Calliope River Basin and crosses Larcom Creek and Raglan Creek.

The nearest Ramsar Wetland is the Shoalwater and Corio Basin area located 60 km northeast of the proposed pipeline route.

The proposed pipeline route transects four REs that are classified and mapped as wetlands according to the Queensland Wetland Mapping and Classification Methodology (EPA, 2005). In clearing the 30 m ROW, up to 23.3 ha would be impacted, representing 0.64% of these REs occurring within the project area (refer to **Section 4.7**). The majority of wetlands observed as being traversed by the proposed pipeline route were narrow bands of fringing riparian vegetation containing limited habitat for aquatic species.

4.5.1.1. Existing watercourses

A total of 54 watercourses were assessed along the proposed pipeline route. Major watercourse crossings identified for the AB mainline and laterals are presented in **Appendix A4.12**, **Volume 3**.

Many of the watercourses anticipated to be traversed by the proposed pipeline route are typical of Australian inland waters, being intermittent with little to no flow during the drier months. Based on an assessment of DERM's database for the minimum and maximum mean monthly flows, it has been determined that most watercourses traversed by the proposed pipeline route have maximum flows in January and February, with the lowest flows in August and September. Inland watercourses generally meander with slow to moderate flows and often have long periods of low or zero flows during which the watercourses can become a series of waterholes (DEWHA, 2007b). A description of aquatic vegetation and an assessment of the riparian vegetation at all significant watercourse crossings is provided in **Section 4.7**.

Of the watercourse crossings assessed, 14 had a stream order of five or greater as assessed using the Strahler (1952) method for stream classification (AECOM, 2011). These watercourses are listed below:

- Suttor Creek;
- Isaac River (four crossings);
- Blackburn Creek (two crossings);
- Clarke Creek;
- Apis Creek;
- Fitzroy River;
- Limestone Creek;
- Scrubby Creek;
- Inkerman Creek; and
- Raglan Creek.

Of the significant watercourses surveyed, 12 of the crossing locations were found to be perennial and are considered to be regionally significant. The majority of watercourses assessed contained no or limited water at the time of the surveys.

The Fitzroy River is the largest river system crossed by the proposed pipeline route with a catchment area of 133,545 km^2 at the proposed crossing location. The Fitzroy River is a large watercourse with a 50 m wide flowing channel at the crossing point (AB319.5).

Other significant crossings include the seasonal Isaac River (AB234) and Raglan Creek (AB446.6).

Waterholes are present at numerous watercourse crossings. Waterholes at Ungle (AB238), Black Gin Creek (AB377.6), Larcom Creek (AB476.2) and the Isaac River (SL19.0) are likely to be permanent or semi-permanent, based on the presence of aquatic flora and fauna and / or landholder knowledge.

Ungle waterhole on Clarke Creek lies adjacent to the ROW at approximately AB236 to AB237. Anecdotal evidence from nearby landholders has suggested that the waterhole is supported by a perched water table. A perched water table is an aquifer that occurs above the regional water table. This occurs when there is an impermeable layer of rock or sediment (aquiclude), or relatively impermeable layer (aquitard), above the main water table/aquifer but below the land surface.

4.5.1.2. Existing water users

The *Water Availability Study* (**Appendix A4.9**, **Volume 3**) identified adequate water resources distributed along the proposed pipeline route. The study also identified available water supply sources and the entities responsible for them.

Water is required for a number of aspects of the project, with the main water requirements being:

- Potable water for use within the temporary workers‘ accommodation camps and for personnel consumption;
- Non-potable water for construction activities including dust suppression, welding, joint coating, vegetation management and weed washdown purposes; and
- Hydrostatic pressure testing water.

There are a wide range of water users within the Burdekin, Fitzroy and Calliope river basins with end use varying from stock and domestic agricultural, industrial and mining, and domestic water supply.

The proposed pipeline route traverses the Fitzroy River in the upper reach of the Fitzroy Water Management Area. The Fitzroy River is a heavily regulated system with users extracting supplemented water in the area immediately downstream of the pipeline crossing. The crossing location (AB319.5) is located within the Eden Bann Weir pool, approximately 1.3 km downstream of the most upstream extent of the pond and within the Lower Fitzroy Supply Scheme area.

The AB mainline and Saraji Lateral both cross the Isaac River. Water use along the Isaac River is generally by unsupplemented water harvesters, such as broad acre irrigators. These users are licensed to extract water from the river in times of high flows.

SunWater operates a number of water supply schemes providing water to mines, towns and rural consumers throughout Central Queensland. The *Water Availability Study* (**Appendix A4.9**, **Volume 3**) identifies sections of the pipeline relative to SunWater owned and operated pipelines or regulated streams. Preliminary discussions have been held with SunWater to discuss potential availability of short term allocations to meet the construction pipeline non-potable water requirements.

4.5.1.3. Existing flooding characteristics

Watercourse crossings will be required for pipe laying and the movement of construction equipment and may be vulnerable to flooding, erosion, scour or landslip. Flooding is considered a potential risk during construction and operation of the pipeline.

An overview assessment of flood levels and extents focussed on crossings of major waterways and where the proposed pipeline route follows the alignment of waterways and drainage paths has been undertaken and is presented in **Appendix A4.12**, **Volume 3**.

Queensland experienced widespread flooding during La Niña years of 1916, 1917, 1950, 1954-1956, 1973-1975 and 2010-2011. The Fitzroy River at Rockhampton has a long and well documented history of flooding, with flood records dating back to 1859.

Eleven locations along the proposed pipeline route where significant lengths of the pipeline may be subject to flood inundation have been identified (GHD, 2011). Only an overview assessment of flood levels was undertaken at this early stage of design. While this flood study was focussed only on identifying locations where significant lengths of the pipeline may be inundated, there are numerous other locations where shorter lengths are likely to be flooded. Further detailed flooding investigations will be undertaken as part of detailed design.

The results of the investigation determining the extent and level of inundation at watercourse crossings are outlined in **Table 4-45**.

Table 4-45: Extent and level of inundation at watercourse crossings along the proposed main alignment and Saraji and Dysart laterals

Kilometre point (KP)	Watercourse	Location description	Catchment area (km^2)	100 yr ARI flow (m^3/s)	Flow estimation method	100 yr ARI flood level (m AHD)	Flood level estimation method	Pipe inundation length (m)
AB12.17	Suttor Creek	Pipeline crosses watercourse	450	1,236	DTMR method	320.89	HEC-RAS model	1,148
AB50.33	Isaac River	Pipeline crosses watercourse	615	1,746	Scaled from upstream stream gauging station "Burton Gorge"	286.58	HEC-RAS model	1,280
AB168.13	Stephens Creek and Isaac River	Pipeline crosses watercourse	7,064.7	17,932	Scaled from downstream stream gauging station "Yatton"	152.27	HEC-RAS model	13,996
AB212.65	Rolf Creek	Pipeline crosses watercourse	1,320	3,132	DTMR method	117.54	HEC-RAS model	2,426
AB238.75	Isaac River	Pipeline crosses watercourse	21,265	36,461	Scaled from stream gauging station "Yatton"	110.84	HEC-RAS model	26,590
AB255.92	Isaac River	Pipeline runs parallel to watercourse	74,825	81,979	Scaled from upstream stream gauging station "Yatton"	-	HEC-RAS model	12,625
AB273.62	Mackenzie River	Pipeline runs parallel to watercourse	74,825	81,979	Scaled from upstream stream gauging station "Yatton"	-	HEC-RAS model	5,119
AB319.53	Fitzroy River	Pipeline crosses watercourse	133,545	30,298	Scaled from upstream stream gauging station "Riverslea"	42.97	HEC-RAS model	6,565
AB447.63	Raglan Creek	Pipeline crosses watercourse	681	5,906	Scaled from upstream stream gauging station "old Station"	14.57	HEC-RAS model	6,425

Kilometre point (KP)	Watercourse	Location description	Catchment area (km^2)	100 yr ARI flow (m^3/s)	Flow estimation method	100 yr ARI flood level (m AHD)	Flood level estimation method	Pipe inundation length (m)
SL19	Isaac River	Pipeline lateral Saraji Rev D crosses watercourse	5,611.7	15,460	Scaled from downstream stream gauging station "Yatton"	173.60	HEC-RAS model	7,431
DL18.3	Stephens Creek	Pipeline lateral Dysart Rev D crosses watercourse	1,453	3,332	DTMR method	-	Conservative Estimate only, based on topography	11,072

Source: Flood Impact Assessment Study (GHD, 2011)

4.5.1.4. Existing water quality

The EPP (Water) sets out the following environmental values that are required to be enhanced or protected:

- Biological integrity;
- Recreational use (primary, secondary and visual);
- Suitability for minimal treatment before supply as drinking water;
- Suitability for agricultural use;
- Suitability for aquacultural use;
- Suitability for producing aquatic food for human consumption;
- Suitability for industrial use; and
- The cultural and spiritual values of the water.

The biological integrity provides an indication of the environmental value of the watercourse as per the biological integrity value discussed in the EPP (Water). These values are assessed as follows:

- Regionally significant: perennial watercourses and / or watercourses that retain water for extended periods of time and therefore may provided valuable flora and fauna habitat;
- Locally significant: ephemeral watercourses that have seasonal significance for plants and animals; and
- Degraded: ephemeral watercourses that have minor significance for plants and animals.

Existing water quality within the Fitzroy Basin is highly variable, ranging from excellent in undisturbed national parks at the top of some catchments through to impacted in lower areas where a range of land uses are present including grazing, cropping, mining and development. Temporal variation in water quality is also high, with rainfall causing pulses of fresh water, pollutants and sediments to be washed into watercourses and influencing water quality characteristics (DERM, 2010).

The majority of watercourses within the project area are highly modified as a result of extensive clearing and existing land use practices, with water generally high in turbidity, metals, nutrients and pesticides. Water quality within the project area is also greatly influenced by rainfall events, with many waterways having an absence of flow for extended periods during the dry season.

Studies of water quality within the Fitzroy Basin have shown that electrical conductivity can be high during the prolonged dry season, decreasing following the arrival of summer rainfall. There is also evidence that background metal concentrations regularly exceed the aquatic ecosystem trigger values outlined in ANZECC (2000), most likely as result of the highly mineralised waters of the Fitzroy River system.

A field assessment of water quality was conducted from 12 to 24 September 2011 to expand on existing information and further describe the water quality of sites to be disturbed by pipeline construction activities. A total of 25 prioritised sites were selected for assessment along the proposed pipeline route on the basis of a desktop study, literature review and the likelihood of available water.

Aquatic ecology surveys were also conducted at sites monitored for water quality, with the results of aquatic ecology surveys are provided in **Section 4.7**.

At each accessible site where water was present, physico-chemical water quality parameters were measured and recorded using a calibrated water quality meter. Parameters included temperature (^{o}C), electrical conductivity (µS/cm), dissolved oxygen (mg/L and %sat) and turbidity (NTU). General observations were also made of water quality conditions at each sampling site. Results were compared with guideline values for the Central Coast Queensland region, published in the Queensland Water Quality Guidelines (DERM, 2009).

Results from field-based water quality assessment are presented in **Table 4-46**, and confirm that watercourses along the proposed pipeline route are relatively degraded across the upland stream (>150 m elevation), lowland stream (<150 m elevation) and estuarine reaches. Along the pipeline route, exceedances of the Queensland Water Quality Guidelines were recorded for electrical conductivity (three sites), pH (12 sites), dissolved oxygen (ten sites) and turbidity (seven sites). The results are consistent with previous studies of the Fitzroy Basin, particularly for a dry season sampling event when low flow conditions are expected.

Table 4-46: Results of physico-chemical water quality assessment at sites along the pipeline route

Site	KP	Name	EC (µS/cm)	pH	DO (%Sat)	Turbidity (NTU)
AP1	AB476	Larcom Creek	1315 (N/A)	8.56 (7-8.4)	77 (70-100)	5 (25)
AP2	AB447	Raglan Creek	Site not accessible			
AP3	AB439	Twelve Mile Creek	8552 (N/A)	8.73 (7-8.4)	95 (70-100)	8 (25)
AP4	AB430	Inkerman Creek	43600 (N/A)	8.05 (7-8.4)	75 (70-100)	329 (25)
AP5a	AB429	Oxbow lagoon off Inkerman Creek	1440 (N/A)	9.73 (7-8.4)	100 (70-100)	35 (25)
AP5	AB426	Inkerman Creek	1942 (N/A)	8.73 (7-8.4)	116 (70-100)	3 (25)
AP6	AB391	Scrubby Creek	1971 (N/A)	8.75 (7-8.4)	90 (70-100)	16 (25)

Site	KP	Name	EC (µS/cm)	pH	DO (%Sat)	Turbidity (NTU)
AP7	AB371	Limestone Creek	2666 (N/A)	8.10 (7-8.4)	79 (70-100)	6 (25)
AP8	AB319	Fitzroy River	914 (340)	9.00 (6.5-8.0)	96 (85-110)	14 (50)
AP9	AB239	Stockyard Creek	No water			
AP9a	AB239	Stockyard Creek	694 (340)	8.88 (6.5-8.0)	98 (85-110)	2 (50)
AP10	AB238	Isaac River Anabranch	No water			
AP12	AB234	Isaac River Anabranch	567 (340)	7.95 (6.5-8.0)	70 (85-110)	18 (50)
AP13	AB217	Bellarine Creek	320 (340)	7.06 (6.5-8.0)	72 (85-110)	696 (50)
AP14	AB216	Isaac River Anabranch	263 (340)	7.78 (6.5-8.0)	78(85-110)	121 (50)
AP15	AB213	Rolf Creek	190 (340)	8.72 (6.5-8.0)	74 (85-110)	277 (50)
AP16	AB172	Blackburn Creek	528 (720)	8.40 (6.5-7.5)	81 (90-110)	22 (25)
AP17	AB165	Isaac River	No water			
AP18a	AB162	Isaac River	624 (720)	7.31 (6.5-7.5)	50 (90-110)	6 (25)
AP23	AB109	North Creek	No water			
AP24	AB105	North Creek	360 (720)	8.05 (6.5-7.5)	88 (90-110)	17 (25)
AP25	AB69	Kenny's Creek	696 (720)	8.27 (6.5-7.5)	85 (90-110)	28 (25)
AP22	AB50	Isaac River	No water			
AP26	SL19	Isaac River	373 (720)	8.09 (6.5-7.5)	87 (90-110)	45 (25)
AP19	SL14	Isaac River	No water			

NOTE: Shaded values exceed the relevant regional guidelines specified in the Queensland Water Quality Guidelines (DERM, 2009) which are presented in brackets for each parameter and site

Exceedances of the guideline values were recorded in the upland stream, lowland stream and estuarine sections of the proposed pipeline route, with only one site (Limestone Creek) having results within the guidelines for all parameters measured. Several sites recorded values outside of the water quality guidelines for multiple parameters. Water quality conditions at estuarine sites were highly variable and are likely to be influenced primarily by differing tidal regimes. Freshwater streams generally comprised turbid pools, with several sites containing clay substrates which were impacted by cattle access. Algal mats were present in some stagnant pools with an oily film or scum present on the surface at some sites. Some exceedances of the dissolved oxygen guideline can be attributed to a lack of flow within watercourses at the time of sampling.

The results of the field assessment confirmed that the water quality of watercourses along the proposed pipeline route is degraded when compared with relevant water quality guidelines, and shows signs of impact from adjacent land uses and previous land uses in the area. During the dry season when rainfall is low, several watercourses are devoid of water or consist of a series of stagnant pools with high turbidity and electrical conductivity.

During the wet season, inputs of fresh rainwater are likely to reduce electrical conductivity through dilution, but may also mobilise sediments and other contaminants if overland flow has occurred. In this regard, water quality within the catchments traversed by the proposed pipeline route is likely to be variable both spatially and temporally, and influenced by rainfall and the activities of mining and agricultural land uses within the catchments.

4.5.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

This section identifies the potential impacts on surface water and watercourses associated with construction and operation of the project as well as identifying mitigation measures. Impacts to aquatic ecology and the related mitigation measures are described in **Section 4.7**.

Key issues related to the management of watercourses associated with all phases of the project include:

- Impact on existing water users including extraction of water from existing watercourses for construction purposes impacting on the availability of water for other use and obstruction and diversion of water flows during construction;
- Erosion and subsequent bank instability;
- Impact of construction on waterholes and sensitive waterways;
- Sedimentation of receiving watercourses; and
- Effects of flooding and buoyancy of the pipeline.

Construction methods for watercourse crossings are described in **Section 3.2.5**.

4.5.2.1. Existing water users

Construction activities have the potential to take or interfere with the flow of water for existing downstream water users.

The project crosses the Fitzroy River in the upper reach of the Fitzroy Water Management Area which is a supplemented water supply area. HDD is proposed for the crossing of the Fitzroy River, subject to geotechnical constraints. HDD will not result in an obstruction or diversion of existing water flows.

In watercourses with flowing water at the time of construction, flows to downstream water users, environment and connectivity for aquatic ecology will need to be maintained throughout construction. This will be done through the use of coffer dams and stream diversion techniques, including dam and pump or flume diversion, where flowing water is present during open cut crossings (as outlined in **Section 3.2.5.1**).

Arrow requires both potable and non-potable water resources to be secured during the construction for general construction purposes and temporary workers‘ accommodation camps. This will have a potential impact on existing water users who currently draw from these waterways. The level of impact will depend on the flows in the watercourses, the needs of the water extractors and the amount extracted by the project, with anticipated volumes identified in **Table 4-47**.

Table 4-47: Potable and Non-Potable Water Demands – Pipeline Construction

Activity	Allowance	Description/Assumptions
Potable water		
Unit Demand Water Usage	250 L/EP/day	Assumed per capita usage for all camp facilities.
Daily Water Use	200 kL/day	Total daily use based on 800 personnel being accommodated at each camp.
Total Water Use at each Camp	12.8 ML	Based on each camp being operational for two construction cycles, with a total construction phase of 320 days.
Total Camp Water Usage	64 ML	For total construction duration
Non-potable water		
Construction Water Demand	500 kL/day	Daily volume to provide dust suppression, vehicular washing and miscellaneous water use during construction.
Total Construction Water Usage	150 ML	Total construction allowances.
Hydrostatic Pressure Testing	100 ML	Based on testing the entire length of the pipeline.
Total Non-Potable Water Usage	250 ML	For total construction duration

Potable water will be sourced from local reticulated water supplies where available.

Non-potable water supply will need to be obtained from an existing non-potable water service provider or existing landholder with available allocations. A range of potential non-potable water resources have been identified. Agreement to utilise a combination of the identified sources will be required to enable reliable access to suitable quality water during the construction phase. The selection of resources will take into account factors including:

- Available capacity and reliability to accommodate the identified water demands;
- Willingness from the water allocation owner to lease the necessary water rights during the construction phase;
- Appropriate water quality for use at the construction site;
- Proximity to the construction sites; and
- Accessible take-off points at the source and adequate transportation route to the site.

It is understood that the volumes of water required during construction of the pipeline will be sourced from existing allocations and therefore will not impact on existing water users downstream.

Relevant approvals and water extraction licences will be required for water harvesting along the proposed pipeline route.

SunWater have advised that they will assist in facilitating negotiated access to water resources for SunWater operated infrastructure. To determine water supply take-off locations, resource availability and relevant contacts for negotiating access will need to be investigated further. A Water Options Study will be undertaken to provide greater detail on available sources and facilitate further development of the water resourcing strategy for the project construction phase.

4.5.2.2. Erosion

Likely erosion sources as a result of project construction include potential scouring of backfilled trenches in creek beds and banks as well as rilling and gullying of the easement on creek approaches and banks. Poor rehabilitation on creek approaches and banks may result in bank failure.

Water velocity and stream power were not assessed as part of the flood assessment for the project. More detailed flooding and bank stability investigations will be undertaken in detailed design to understand erosion risk at each watercourse crossing.

The greatest risk will be during the initial wet season flows following construction but prior to successful rehabilitation. High discharge velocities, as well as variations in velocity or flow path, could lead to failure of rehabilitation along the ROW. This is especially true of dispersive soils in approaches to streams. Rain could collect in the unconsolidated trench, backfill and trace the trench downslope toward the nearest stream, resulting in gullying of the trench and possible bank failure. Sheet flows could collect in shallow depressions over the backfilled trenches and channelise, causing rilling and gullying.

Crossing sites will be selected to avoid where practical:

- Unstable banks;
- Deep pools;
- Rock basements or rock outcrops in the channel; and
- Confluences with other channels.

Erosion of cover is also possible at creek and river crossings during the operation phase, especially on the banks. For the majority of the creek and river crossings, increased depth of cover of 1200 mm will be used and protection measures installed on the banks as required by the crossing design.

Diversion banks at the crest of stream approach slope and on slopes will be used to divert sheet flow away from backfilled trenches.

Where an access track is required through a watercourse, this will generally be placed on the downstream side of the pipeline to minimise the potential for future erosion over the pipeline where practicable.

Creek banks will be profiled and reinstated as near as practicable to their former profile following construction. Accordingly, there will be no change to the hydraulic regimes of any watercourse following construction and rehabilitation. Consideration will be given to seeding watercourse embankments with a fast-growing native grass (e.g. *Themeda australis*) or other suitable fast-growing species, or the use of hydro mulching (in the event of dry conditions) to aid in rehabilitation. Where practicable, large trees will be retained. Root stock will, wherever practicable, be retained for stabilisation of the banks.

Given the narrow width of the ROW and the implementation of erosion management strategies as outlined in **Section 4.5.2.4** and the EMP (**Chapter 5**), potential land slippage is considered unlikely. A sediment and erosion control plan will be developed to minimise erosion and sediment loss during construction and promote rapid effective rehabilitation of watercourse crossings. Construction of watercourse crossings will be scheduled during the dry season. HDD is also proposed (subject to geotechnical constraints) at the Fitzroy River (AB319.5), the Isaac River (AB234) and Raglan Creek (AB446.6) which will minimise the potential for any land slippage in these areas.

Ongoing inspection of watercourses during operation will be undertaken and remedial action will be initiated where required

4.5.2.3. Waterholes and sensitive waterways

Several waterways along the pipeline alignment will be highly sensitive to construction impacts. Waterholes were present at numerous watercourse crossings. Ungle waterhole (AB238), Black Gin Creek (AB377.6), Larcom Creek (AB476.2) and the Isaac River (SL19.0) are likely to be permanent or semi-permanent based on the presence of aquatic flora and fauna and / or landholder knowledge.

At some crossings, an alternative nearby crossing point was identified that reduced potential impacts (e.g. existing clearing, less steep banks, smaller channel, less permanent water). In these instances, **Appendix A4.12**, **Volume 3** provides details of the original crossing point and the new alternative crossing point.

Anecdotal evidence from landholders suggests that Ungle waterhole may supported by a perched aquifer. A perched water table is an aquifer that occurs above the regional water table. This occurs when there is an impermeable layer of rock or sediment (aquiclude), or relatively impermeable layer (aquitard), above the main water table/aquifer but below land surface. If a perched aquifer's flow intersects the surface, the water is discharged as a spring. Drilling through an aquiclude poses a risk to interconnecting the two water tables, which could result in the draining of the perched table (fully or partially) resulting in potential impacts to beneficial uses of the perched aquifer and therefore open trenching of the Isaac River and Clarke Creek may be required in lieu of HDD. This will be the subject of ongoing geotechnical assessment during detailed design.

Pre-stripping and stockpiling of topsoil and bed material will be in accordance with the EMP and stored above the bank where it will not be buried or damaged, with topsoil and bed material stockpiled separately.

Stormwater diversion drains will be placed near to the top of the banks of the watercourse and at an appropriate distance back from each side of the top of the watercourse embankment.

The disturbance corridor for the bed, bank and approaches to watercourses will be the narrowest practicable for safe construction.

Training and induction of construction and maintenance crews will include environmental values associated with stream channels (e.g. habitat, water quality and areas of downstream significance).

Construction, maintenance and decommissioning activities will follow the Australian Pipeline Industry Association (APIA) guidelines.

Provided mitigation measures are implemented, the majority of watercourses can be crossed using conventional open cut techniques without significant impacts on ecological values and water quality. Where potential significant impacts have been identified with open cut techniques, such as the Fitzroy River, Isaac River and Raglan Creek, HDD has been proposed (subject to geotechnical investigation).

4.5.2.4. Sedimentation of receiving waters

Pipeline construction activities have the potential to affect water quality at watercourse crossings subject to flowing water, primarily through the potential disturbance and mobilisation of sediments, increasing turbidity and potentially mobilising contaminants such as metals, pesticides and nutrients. The risk of these impacts is increased during periods of moderate to high flow, when disturbed sediments can be mobilised and transported large distances downstream.

The potential impacts of construction activities on water quality at watercourse crossings will be mitigated by scheduling waterway crossing works during the dry season when the majority of watercourse crossing sites are dry or composed of detached pools. The locations of pipeline crossing sites have been selected to avoid deep pools and unstable banks, and this will assist in minimising the disturbance of watercourses and in maintaining existing water quality values, noting that at many sites, water quality is already degraded.

Where construction works are carried out at watercourses which are flowing, water quality will be monitored at locations upstream and downstream of the works area. This will ensure that environmental management procedures are effective in minimising impacts on existing water quality values. Erosion control structures, such as sediment fences, floatation curtains, hay bales and sand bags, will be placed in and/or adjacent to the channel to capture suspended sediment and to confine any impacts locally to the vicinity of construction activities. This will minimise the scale and extent of any impact of works on water quality, with particular reference to reducing any increase in turbidity and total suspended solids.

Where the ROW crosses large, flowing rivers, such as the Fitzroy River, Isaac River and Raglan Creek, HDD may be used to minimise ecological impacts during construction and reduce rehabilitation requirements, subject to geotechnical constraints. Earthworks will be ceased during inclement wet weather, when necessary, to prevent avoidable sedimentation.

Other potential impacts to water quality relate to the discharge of wastes arising from construction equipment and techniques. These impacts will be minimised by ensuring that all refuelling of plant and equipment is undertaken at least 50 m from the nearest watercourse. Additionally, waste and dangerous goods management strategies will be adopted at all times.

Water derived from hydrostatic testing of the pipeline will not be discharged directly to watercourses. Test water will be discharged to land or a holding pond for evaporation or subsequent beneficial use, and will be in compliance with regulatory and landholder requirements.

The implementation of effective environmental management procedures will minimise impacts associated with construction activities. Given the degraded nature of water quality within watercourses along the proposed pipeline route, construction activities are not expected to have any significant impact on existing environmental values.

4.5.2.5. Flooding

The flood assessment considered locations where significant lengths of the proposed pipeline route would be inundated during a 100 year ARI event. The purpose of this investigation was to identify areas of the project where buoyancy controls may be utilised.

Creek crossings where shorter lengths of pipe are inundated in a flood event were not assessed as part of this study but will be assessed in detailed design to assess the need for concrete coated pipe or concrete anchors to prevent the pipe from floating.

The low lying areas identified in the location analysis as prone to flooding may require buoyancy control measures. These measures will include extra depth (1,200 min. depth of cover), concrete coating of the pipeline, set on weights, or other buoyancy control measures (or a combination thereof) to ensure that the pipe is negatively buoyant.

The construction of the proposed pipeline will be scheduled during the dry season to minimise potential impacts on flooding during construction.

Operation of the pipeline is not expected to be impacted by flooding.

Various route options were looked at in the Rockhampton / Gracemere area.

The SGIC SDA and PNG Queensland Gas Pipeline corridor traverse the extensive lagoon systems of the Fitzroy River floodplain in the vicinity of Rockhampton. Recent heavy rains and flooding have shown extensive inundation of land traversed by these pipeline corridors. The extent of flood inundation of the SGIC SDA in this area is shown in **Figure 3-1**. In contrast, the Gladstone Nickel (slurry) Pipeline route was observed to be largely unaffected by flooding. Accordingly the adoption of the proposed slurry pipeline route south of Rockhampton offers the greatest protection from flood immunity for the proposed pipeline route.

Potentially flooded areas will be further investigated and considered in the detailed design.

4.5.3. SUMMARY

Potential impacts of crossing watercourses and available mitigation and management measures are outlined in **Table 4-48**.

Table 4-48: Project commitments for water

Issue	Commitment
Water levels and flows	▪ HDD to be investigated for the crossing of major waterways (subject to geotechnical investigation) such as the Fitzroy River, Isaac River and Raglan Creek. ▪ Flows to downstream water users and environment will need to be maintained throughout construction in flowing waterways. ▪ Flow diversion techniques will be used where flowing water is present during open cut crossings to minimise increase in turbidity. ▪ Additional stormwater diversion banks/drains (e.g. whoa-boys) are to be placed at a distance of 10 m bank from each side of the top of the watercourse embankment. ▪ Construction of watercourse crossings will be scheduled during the dry season wherever practicable when the intermittent rivers and streams traversed by the pipeline are generally not in flow.
Water supply	▪ Water required during construction of the pipeline will be sourced from existing allocations. ▪ Relevant approvals and water extraction licences will be gained for water harvesting along the alignment, where required. ▪ A Water Options Study will be undertaken to provide greater detail on available sources and facilitate further development of the water resourcing strategy for the project construction phase.

Issue	Commitment
Bank erosion and scour	▪ The crossings, including vehicular and maintenance tracks, will typically be at right angles to the direction of water flow to minimise scour potential. ▪ If the watercourse contains a sandy substrate, consideration will be given to the use of rock stabilisation for addition to the channel and embankments to prevent scour. ▪ Creek banks will be profiled and reinstated as near as practicable to their former profile following construction. ▪ Where practicable, large riparian trees and rootstock will be retained for bank stabilisation. ▪ Ongoing inspection of watercourses during operation will be undertaken and remedial action will be initiated where required. ▪ Relevant permits (including waterway barrier permits and permits to clear threatened vegetation) will be obtained where required. ▪ Clearing widths should be minimised in the beds of watercourses.

Bank erosion	▪ Crossing sites selected to avoid where practical:
	  ▪ Unstable banks;
	  ▪ Deep pools;
	  ▪ Rock basements or rock outcrops in the channel;
	  ▪ Confluences with other channels.
	▪ Consideration will be given to seeding watercourse embankments with a fast-growing native grass (e.g. *Themeda australis*) or other suitable fast-growing species, or the use of hydro mulching (in the event of dry conditions) to aid in rehabilitation, where required.
	▪ Diversion banks placed at the top of banks of streams will be used to divert sheet flow away from the rehabilitated ROW.
	▪ Ongoing inspection of watercourses during operation, and remedial action will be initiated where required.
	▪ Watercourse banks will be reinstated as near as possible to their former profile, stabilised and revegetated as necessary to prevent scouring.
	▪ Where practicable, large trees will be retained. Root stock will, wherever practicable, be retained for stabilisation of the banks.
	▪ Watercourse crossings will be completed promptly and with due regard to the weather.
	▪ During restoration, the creek or gully walls should be re-established to a stable slope consistent with the natural slope on either side of the disturbed area.
	▪ Monitoring of the watercourses before, during and after construction shall be undertaken to ensure that rehabilitation works and stability of the watercourses is comparable to pre-construction conditions.

Issue	Commitment
Riparian ecosystems and habitats	▪ Pre-stripping and stockpiling of topsoil and bed material will be in accordance with the EMP and stored above the bank where it will not be buried or damaged, with topsoil and bed material stockpiled separately. ▪ The disturbance corridor for the bed, bank and approaches to watercourses will be the narrowest practicable for safe construction. ▪ Training / induction of construction and maintenance crews will include environmental values associated with stream channels (e.g. habitat, water quality and areas of downstream significance). ▪ The Weed Management Plan being developed and implemented shall apply to the whole of the project and shall include incursion into riparian areas at watercourse crossings.
Water quality	▪ The water quality of watercourses, if flowing, shall be monitored at wet crossings both upstream and downstream of the construction area. ▪ At wet crossings, erosion control structures (such as sediment fences, floatation curtains, sand bags and hay bales) will be placed in the channel and/or stream banks to capture suspended sediment. ▪ Where it is necessary to pump water around the watercourse crossing, the outlet water should not be directed onto the bank of the watercourse. ▪ Temporary earth banks shall be installed along the slope on approaches to watercourses immediately following clear and grade. This bank shall extend beyond the easement edge, in a manner which results in runoff water being discharged to the down-slope side of the pipeline to stable, preferably vegetated discharged sites.
Headward erosion along the proposed pipeline	▪ Assessment of minimum depth requirements to be completed during detailed design. ▪ Minimum depth of cover of 1200 mm for watercourses. ▪ Stable banks through the implementation maintenance of stormwater diversion drains. ▪ Where an access track is required through a watercourse, this will generally be placed on the downstream side of the pipeline to minimise the potential for future erosion over the pipeline where practicable.
Flooding	▪ Detailed design to take into account any pipe buoyancy from flooding of waterways. ▪ Meteorological forecasts (e.g. BOM website) will be monitored for storm and heavy rain events to assist in scheduling key activities. ▪ Watercourse crossings will be completed promptly and with due regard to the weather (i.e. construction will be scheduled for the dry season and postponed during significant rainfall and/or flood events). ▪ In the event of flooding, remedial action will be taken in accordance with the Construction Emergency Response Plan where necessary.

Issue	Commitment
Hydrostatic testing	▪ The Hydrostatic test water will not be disposed of directly to watercourses. ▪ Test water shall be discharged to land or a holding pond / farm dam (for evaporation or subsequent beneficial use) and will be in compliance with regulatory and landholder requirements with all necessary permits obtained. ▪ No refuelling of plant and equipment will be undertaken within 50 m of watercourses. ▪ Waste and dangerous goods management strategies (as described in **Section 4.4.2** and **Section 4.13.2**) will be adopted at all times.

4.6. AIR

This section assesses the potential air quality and greenhouse gas impacts associated with the project.

Legislation, policies and guidelines

The potential air quality and greenhouse gas impacts associated with the project is based on relevant legislation, policies and guidelines as summarised in **Table 4-49**.

Table 4-49: Legislation, policies and guidelines

Legalisation	Relevance
*Environmental Protection Act 1994 (*EP Act*)*	▪ Provides for the management of the air environment in Queensland.
Queensland Environment Protection (Air) Policy 2008 (EPP(Air))	▪ Provides air quality guidelines as specified by DERM.
National Greenhouse and Energy Reporting Act 2007	▪ Provides for the reporting and dissemination of information about the greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations.
The National Greenhouse Accounts (NGA) *Factors 2011*	▪ Prepared by the Department of Climate Change and Energy Efficiency (DCCE) and is designed for use by companies and individuals to estimate greenhouse gas emissions.

Methodology

The assessment of potential air quality and greenhouse gas impacts in relation to the proposed pipeline route and the project area is based on:

- A review of relevant legislation and ambient air quality goals;
- A review of the existing air environment, including air quality within the project area;

- Identification of the receptors within 1 km either side of the proposed pipeline route;
- A qualitative assessment of the potential air quality impacts from the construction and operation of the project; and
- The preparation of a greenhouse gas emissions inventory from the construction and operation of the project and identifying mitigation measures.

Assessment of the construction phase is qualitative only as it is not possible to model these types of dust impacts effectively (quantitative assessment). Construction impacts are dependent on a great number of variables, including the number of plant required, operation methods of plant and maintenance and condition of plant.

Air quality objectives

Ambient air quality guidelines in Queensland are provided in the EPP (Air). These guidelines are consistent with guideline values published in the National Environment Protection Measure (NEPM) (Ambient Air Quality) and the NEPM (Air Toxics).

The air quality objectives for the project are shown in **Table 4-50**. No formal criteria for dust deposition exist in Queensland. However, an informal guideline of 120 milligram/metres squared per day (mg/m^2/day) has been adopted by DERM and is applicable to the identified sensitive residential dwellings along the proposed pipeline route.

Table 4-50: Ambient air quality objectives

Environmental Value	Pollutant	Air Quality Objective	Averaging Period	Allowance Exceedances
Human Health	Particulate matter (PM10)	50 microgram (µg)/metres cubed (m^3)	24 hours	5 days each year
	Total Suspended Particulates	90 µg/m^3	1 year	none
Nuisance	Dust Deposition	120 mg/m^2/day	1 month	none

In evaluating the air quality impacts associated with construction and operation of the pipeline, the air quality objectives in **Table 4-50** were identified. The primary pollutant of concern is particulate matter (in this case construction dust) associated with earth works during the construction. Particulate matter associated with construction is predominately course (i.e. greater than 2.5 µm), relatively inert and short term in duration. Fine particulate goals will be met provided that dust from construction is controlled within the identified PM10 guidelines for health.

Greenhouse gas

The greenhouse gas impacts of the construction and operation of the pipeline have been assessed by:

- Presenting an inventory of projected annual emissions from construction to operation; and
- Identifying mitigation measures to reduce greenhouse gas emissions.

A preliminary greenhouse gas inventory has been prepared for the construction and operation of the project. The National Greenhouse Accounts (NGA) Factors (DCCEE, 2011) were used in the preparation of the estimated greenhouse gas inventory. The relevant emission factors are summarised in **Table 4-51**.

Table 4-51: Greenhouse Gas Emission Factors

Source	Emission Factor				Energy Content Factor (GJ/kL)	Derived Emission Factor
	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)	Units		
Diesel oil (stationary energy)	69.2	0.1	0.2	t CO_2-e/GJ	38.6	2.681 (t CO_2-e/kL)
Diesel oil (transport energy)	69.2	0.1	0.5	t CO_2-e/GJ	38.6	2.71 (t CO_2-e/kL)
Natural gas transmission	0.02	8.7	-	t CO_2-e/km	-	8.72 (t CO_2-e/km)

[1] Derived E.F = Σ EF (CO_2 + CH_4 + N_2O) x Energy Content / 1000

Source: DCCEE 2011

Australia reports greenhouse gas emissions and carbon sequestration from land use change and forestry according to the rules that apply to its 108% Kyoto Protocol emissions target, and to meet obligations under the United Nations Framework Convention on Climate Change (UNFCCC). As such, the Australian Government has developed a tool called the National Carbon Accounting System (NCAS) to estimate above and below ground greenhouse gas stores/emissions for land based activities.

Forestry activities (afforestation and reforestation) included under these Kyoto provisions are those that establish a forest of trees:

- With a potential height of at least two metres and crown cover of at least 20 per cent;
- In patches greater than 0.2 ha in area;
- Since 1 January 1990, on land that was clear of forest at 31 December 1989;

- By direct human induced methods; and
- Within Australia.

Under the UNFCCC, accounting requirements cover a broad range of forestry activities, including the growth, harvesting and regrowth of all managed native forests and plantations (including plantations that meet the above criteria as well as plantations established prior to 1 January 1990 or on land that was forested at 31 December 1989).

Ecological assessments undertaken for the project have identified that the majority of the proposed pipeline route (approximately 73%) runs through non-remnant vegetation, mainly comprising cropping and grazing land which does not meet the Kyoto Protocol definition of a forest (see above). As such, and in accordance with the NCAS, removal of vegetation has been found to have a minimal impact to the GHG emissions of the project.

4.6.1. DESCRIPTION OF ENVIRONMENTAL VALUES

4.6.1.1. Existing air environment

Air Quality

The existing air quality along the proposed pipeline route is influenced by local and regional sources including:

- Coal mines;
- Windblown dust from exposed agricultural land and unsealed roads;
- Dust storms and bushfires (agricultural burning);
- Motor vehicle emissions from local, regional and state highways along the pipeline; and
- Industrial sources around Rockhampton and Gladstone.

DERM has a network of air quality monitoring stations in central and northern Queensland (including Gladstone, West Mackay and Townsville) to measure pollutants typical of the region and its activities. Gladstone's air quality is heavily influenced by industrial sources and is not considered representative of the rural nature of much of the project area.

Ambient air quality monitoring data recorded at West Mackay monitoring station has been reviewed to describe existing air quality within the project area. The West Mackay station is located approximately 120 km east of the northern extent of the proposed pipeline route (i.e. east of AB0).

Air quality in Mackay is influenced by major roads, light industry, dust storms, bushfires and sugar cane burning. **Table 4-52** presents ambient air quality monitoring results for the West Mackay monitoring station.

Table 4-52: Ambient air quality for West Mackay

Pollutant	Avg Period	Air Quality Objective	Concentration (µg/m³)			
			Year	Max	90%	Average
PM_{10}	24 hours	50 (µg/m³)	2008	307	42	23
			2007	298	37	22
			2006	209	33	20
			2005	332	38	22
			2004	141	35	21

Due to the rural nature of the land along the proposed pipeline route, background air quality data is generally expected to be good. Typically particulate concentrations are expected to be lower along the proposed pipeline route than recorded at West Mackay. Natural events such as dust storms and bushfires may result in exceedances of the above air quality objectives.

Climate and dispersion meteorology

A summary of the climatic conditions has been presented in **Section 4.1**.

Climatic conditions may influence the potential air quality impacts during construction. Climatic conditions likely to generate more dust from construction include:

- Extended periods of low rainfall; and
- High wind speeds generating increased dust from exposed stockpiles and cleared land.

4.6.1.2. Sensitive receptors

Sensitive receptors are at locations which have the potential to be impacted by air emissions from the project. Air quality sensitive receptors within the project area include:

- Residential dwellings;
- Educational facilities (e.g. schools, kindergartens, child care centres, and schools);
- Medical institutions (e.g. hospitals and surgeries);
- Public parks and recreational areas; and
- Religious buildings (e.g. churches).

A total of 119 residential dwellings have been identified within a 1 km buffer either side of the proposed pipeline route. Only two houses are located within 100 m of the ROW at AB398 (approximately 77 m from the proposed pipeline route) and AB440 (approximately 92 m from the proposed pipeline route).

In addition, the following facilities have been identified within 1 km of the proposed pipeline route near AB468:

- One police station (Mt Larcom);
- One library (Mt Larcom);
- Mount Larcom Ambulance Station; and
- Mount Larcom State School.

Sensitive receptors are shown on **Map series 8**, **Volume 2**.

4.6.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

Construction

The construction works of the project is expected to occur for a period of approximately 15 months, with the standard hours of work from 6.00 am to 6.00 pm, Monday to Sunday. During this time, the construction activity will generally progress from one end of the proposed pipeline route to the other. The duration of construction activity at any location along the route will depend on the terrain and other factors, but should be a number of weeks, rather than months. Most of the air quality impacts are associated with the bulk earthworks, which will be limited in duration at any one point along the pipeline route. The route may have limited air quality impacts at any one point after successful rehabilitation.

The main types of air emissions associated with the project are from particulate matter (dust) and to a lesser extent the combustion products of construction vehicles. The exhaust emissions include combustion products such as carbon monoxide (CO), nitrogen dioxide (NO_2) and PM_{10}. Due to the nature of the project, both in terms of vehicles used and a non-static construction site, these emissions are extremely low and are not considered to be a significant impact. There will be no sources of odour during the construction of the pipeline.

Construction of the proposed pipeline route will require a ROW to be cleared, trenched, backfilled and restored. During the construction phase the following activities have the potential to generate dust emissions at the nearest sensitive receptors:

- Clear and grade;
- Stringing and welding;
- Joint coating;
- Trenching;

- Lowering-in and backfilling;
- Crushing;
- Traffic on unsealed roads;
- Clean-up, restoration and rehabilitation; and
- Commissioning.

The construction of the proposed pipeline route will result in a temporary, intermittent short term increase in levels of traffic due to the delivery of equipment and materials. These vehicles will only use SCRs and local road networks when travelling to and from the ROW each day. The increase in traffic is expected to have minimal impact on air quality.

The dust emissions generated from the project are likely to have a temporary short term impact on the project area during surface works operation. It is very unlikely construction will result in exceedances of the air quality objectives described in EPP (Air). There is potential for nuisance impacts at sensitive receptors within 1 km either side of the proposed pipeline route.

The following mitigation measures will be implemented to minimise the potential for nuisance dust impacts during project construction:

- The speed of light vehicles on the ROW will be limited to reduce wheel-generated dust;
- Watering trucks will be in the construction fleet at all times and will be used to control dust in dry and/or windy conditions;
- Plant or equipment are not to be parked idling for extended periods of time;
- Maintaining operation and exhaust systems of construction plant, vehicles and machinery in accordance with manufacturers' recommendations to minimise emissions to the atmosphere;
- Progressive rehabilitation to be undertaken following installation of the pipeline; and
- A complaints register will be maintained and all complaints will be investigated promptly.

Operation

The main impacts from the project during the operational phase will be from vehicles periodically travelling to and from the ROW for maintenance and inspection purposes. The volume of traffic is expected to be minimal and is described in **Section 4.3**.

Fugitive emissions from project operations are extremely low. There are no scheduled releases of gas other than extremely small quantities associated with the pipeline pigging activities and other limited releases during certain routine operational activities (e.g. valve testing). The gases released during the pigging activities are primarily methane and are not identified as air pollutants or odorous compounds and will not have an impact on air quality.

Only relatively minimal impacts on local air quality are expected from the occasional operational traffic associated with the project, and that the effect of the project itself on local air quality is negligible, no mitigation measures are proposed with respect to occasional operational traffic.

4.6.2.1. Greenhouse gases

Estimates of greenhouse gas emissions for the construction of the project are presented in **Table 4-53**. The vehicle fleet includes trucks, cranes and side booms, tip trucks, excavation machinery, mobile welding plant, drilling and boring equipment and personnel transport vehicles.

Greenhouse gas emissions from on-site welding have not been included in this assessment as the equipment is electric arc welding powered by a vehicle mounted diesel generator on the back of a 4-wheel drive (4WD) vehicle. Emissions are considered to be relatively small, being equivalent to a single diesel 4WD vehicle.

Table 4-53: Greenhouse gas emissions for the construction of the project

Source	Usage (units)	Emission factor	GHGs (t CO_2-e)
Diesel generators	8,760 kL	2.68	23,477
Construction equipment	11,200 kL	2.68	30,016
Light vehicles	40 kL	2.70	108
		Annual TOTAL	**26,801**
		Project TOTAL	**53,601**

Source: DCCEE 2011

The construction of the project is estimated to result in approximately 53,601 t CO_2-e of greenhouse gases representing 26,801 t CO_2-e on an annual basis. The annual emissions represent a small fraction of Queensland‘s (0.02%) and Australia‘s (0.005%) annual greenhouse gas emissions of 155.1 Mt CO_2-e (DCCEE 2010) and 564.4 Mt CO_2-e (DCCEE 2010) for the 2009 reporting year.

Estimates of the greenhouse gas emissions for the operation of the project are presented in **Table 4-54**. Fugitive emissions of gas can occur due to leakage from pipeline infrastructure such as valves, flanges, seals and connections.

Table 4-54: Greenhouse gas emissions for the operation of the project (per year)

Source	Pipeline length (km)	Emission factor (t CO2e/km.yr)	GHGs (t CO_2-e)
Natural gas transmission	600	8.72 t CO2e/km.yr	5,232
		TOTAL	**5,232**

Source: DCCEE 2011

Australia reports greenhouse gas emissions and carbon sequestration from land use change and forestry according to the rules that apply to its 108% Kyoto Protocol emissions target, and to meet obligations under the United Nations Framework Convention on Climate Change (UNFCCC). As such, the Australian Government has developed a tool called the National Carbon Accounting System (NCAS) to estimate above and below ground greenhouse gas stores/emissions for land based activities.

Forestry activities (afforestation and reforestation) included under these Kyoto provisions are those that establish a forest of trees:

- with a potential height of at least two metres and crown cover of at least 20 per cent;
- in patches greater than 0.2 hectare in area;
- since 1 January 1990, on land that was clear of forest at 31 December 1989;
- by direct human induced methods; and
- within Australia.

Under the UNFCCC, accounting requirements cover a broad range of forestry activities, including the growth, harvesting and regrowth of all managed native forests and plantations (including plantations that meet the above criteria as well as plantations established prior to 1 January 1990 or on land that was forested at 31 December 1989).

Ecological assessments undertaken for the project have identified that the majority of the proposed pipeline route (approximately 73%) runs through non-remnant vegetation, mainly comprising cropping and grazing land which does not meet the Kyoto Protocol definition of a forest (see above). As such, and in accordance with the NCAS, removal of vegetation has been found to have a minimal impact to the GHG emissions of the project.

The operation of the project is estimated to result in approximately 5,232 t CO_2-e of greenhouse gases on an annual basis. The annual emissions represent a small fraction of Queensland's (0.003%) and Australia's (0.0009%) annual greenhouse gas emissions of 155.1 Mt CO_2-e (DCCEE 2010) and a 564.4 Mt CO_2-e (DCCEE 2010) for the 2009 reporting year.

The mitigation measures to minimise greenhouse gas emissions as part of the construction works of the project include:

- Optimising the construction works program to minimise haul distances for most construction materials to reduce fuel use;
- Maximising beneficial use of cleared material;
- Maintaining construction equipment and haul trucks in good working order so fuel efficiency of equipment is maximised;
- Using appropriately sized equipment for construction activities;
- Avoiding engines running (idling) for extended periods;
- Raising awareness of energy efficiency and greenhouse gas emissions through workshops or toolkit talks;
- Minimising waste from construction (**Section 4.4**); and
- Investigating greenhouse gas reduction initiatives at temporary workers' accommodation camps.

The construction contractor will be responsible for the efficient use of diesel during construction. The construction methodology is standard practice for the construction of a gas pipeline and the greenhouse gas emissions will be similar to other projects of this nature.

The ongoing maintenance of the pipeline is expected to result in minimal releases of gas. Any welding repairs will most likely be conducted in situ without the need for shutting down the pipeline without the need for any gas purging. Pitting of the welds will be greatly reduced due to the application of a protective coating and the utilisation of cathodic protection to protect the integrity of the pipeline. With the aid of these preventative maintenance measures, the need to remove large sections of the pipe and potential gas release is highly unlikely to occur.

The following management measures will be implemented for the operation of the project to minimise greenhouse gas emissions:

- Reviewing annual energy use to assist in identifying opportunities to improve the energy efficiency of operations;
- Reducing and eliminate accidental releases of gas; and
- Regular monitoring of the cathodic protection system.

The design of the pipeline has been selected to reduce fugitive gas emissions through the use of a fully welded steel pipeline protected by an external protective coating and a cathodic protection system engineered to detect corrosion that might compromise the continued long term integrity of the pipeline.

Arrow is required to estimate and report annual greenhouse gas emissions under the National Greenhouse and Energy Reporting System. The development of consistent data capture and reporting processes will assist with the ongoing management of Arrow's greenhouse and energy management programs.

4.6.3. SUMMARY

It is considered unlikely that the project will result in exceedances of the EPP(Air) guidelines if appropriate mitigation measures are implemented throughout the construction period.

Greenhouse gas emissions from construction and operation of the project represent a small fraction of Queensland greenhouse gas emissions.

The key commitments outlined with regards to the management of air quality and greenhouse gas emissions have been summarised in **Table 4-55**.

Table 4-55: Project commitments for air quality and greenhouse gases

Issue	Commitment
Nuisance (dust)	▪ Watering trucks will be employed to control dust in dry and/or windy conditions. ▪ Progressive rehabilitation will be undertaken along the pipeline route following completion of construction. ▪ A complaints register will be maintained and all complaints will be investigated promptly. ▪ The speed of light vehicles on the ROW will be limited to reduce wheel-generated dust.
Greenhouse gas emissions	▪ Maintain construction and haul equipment in line with manufacturers' recommendations. ▪ Optimise the construction works program to minimise haul distances for most construction materials to reduce fuel use; ▪ Maximise the beneficial use of cleared material. ▪ Avoid engines running (idling) for extended periods.

4.7. NOISE AND VIBRATION

This section provides an assessment of the potential noise and vibration impacts of the project.

Legislation, policies and guidelines

The potential noise and vibration impacts associated with the project are based on relevant legislation, policies, and guidelines as summarised in **Table 4-56**.

Table 4-56: Legislation, policies and guidelines

Legalisation, policies and guidelines	Relevance
Environmental Protection Act (1994) (EP Act)	▪ Provides for the management of the noise environment in Queensland.
Environmental Protection (Noise) Policy 2008 (EPP(Noise));	▪ Provides noise quality guidelines as specified by the Department of Environment and Resource Management (DERM).
Noise and Vibration from Blasting (2006) Ecoaccess guideline.	▪ Provides an assessment criterion for blasting noise and vibration.

Relevant national and international standards

The following standards are also relevant to the noise and vibration assessment:

- Australian Standard (AS) 2436:1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*;
- British Standard BS6472-1992 - *Evaluation of Human Exposure to Vibration in Buildings*; and
- British Standard BS7385-1993 - *Assessing the effects of vibration on structures*.

Methodology

The assessment of potential noise and vibration impacts in relation to the proposed pipeline route and the project area is based on:

- A review of applicable construction and operational noise and vibration goals and criteria for the project, using relevant legislation, policies, guidelines and standards, including the EPP (Noise);
- A review of the existing noise and vibration environment within the project area;
- An identification of the sensitive receptors within a 1km buffer either side of the proposed pipeline route;
- An assessment of potential noise and vibration impacts at nearest sensitive receptors during construction and operation of the project; and
- An identification of potential mitigation measures which could be incorporated into the project to minimise the potential for impacts.

Unattended noise monitoring

Unattended noise monitoring was conducted in accordance with AS1055 *Acoustics – Description and measurement of environmental noise*, using four Rion NL21 type two noise monitors and one Bruel & Kjaer 2238 type one noise monitor. Noise monitors were calibrated in accordance with NATA standards, and were set to record statistics at 15 minutes intervals throughout the monitoring period. Microphones were set at 1.5 m above the ground level, and loggers were placed away from obvious local noise sources, such as pumps or transformers.

When measuring noise levels, the use of statistical descriptors is necessary to understand and describe how variations in the noise environment occur over any given period. Descriptors used in this noise assessment include:

- L_{A1} – For a specified time interval, means the A-weighted sound pressure level that is equalled or exceeded for 1% of the interval. This is often used as an impact index when assessing noise emissions from activities;
- L_{A10} – For a specified time interval, means the A-weighted sound pressure level that is equalled or exceeded for 10% of the interval. This is often used as an impact index when assessing noise emissions from activities;
- L_{A90} – For a specified time interval, means the A-weighted sound pressure level that is equalled or exceeded for 90% of the interval. This is considered as the background noise level;
- L_{Aeq} – The time average A-weighted sound pressure level for a specified interval. This index is also used as an impact index; and
- L_{Amax} – For a specified time interval, means the highest momentary sound pressure level over a noise event(s).

The assessment of the noise and vibration impacts associated with the project is based on the following assessment criteria.

Noise criteria

There are currently no construction specific noise criteria in Queensland, other than for noise from blasting. Schedule 1 of the EPP (Noise), however, establishes long term acoustic quality objectives for enhancing or protecting the environmental values. The acoustic quality objectives, used as a guide for the project, are shown in **Table 4-57**.

Table 4-57: Schedule 1 Acoustic Quality Objectives

Sensitive receptor	Time of day	Acoustic quality objective (measured at the receptor) dB(A)			Environmental value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Dwelling (for outdoors)	daytime and evening	50	55	65	health and wellbeing
Dwelling (for indoors)	daytime and evening	35	40	45	health and wellbeing
Dwelling (for indoors)	night-time	30	35	40	health and wellbeing, in relation to the ability to sleep
Park or garden that is open to the public for use other than for sport or organised entertainment	anytime	the level of noise that preserves the amenity of the existing park or garden			community amenity

Vibration criteria

There are no vibration criteria in Queensland for the specific assessment of construction vibration impacts with the exception of those due to blasting.

For the project, the continuous vibration limits for human perception and structural damage, drawn from BS6472 and BS7385, are recommended and shown in **Table 4-58**.

Table 4-58: Continuous vibration limits for the different locations

Location	Thresholds
Critical working areas	0.4 mm/s
Residential dwellings	1.6 mm/s
Commercial premises	3.2 mm/s

Levels for assessing the effects of vibration on structures are provided in the vibration velocity guideline BS7385- Part 2:1993. These are summarised in **Table 4-59**.

Table 4-59: BS 7385 - Transient Vibration Guide Values for Cosmetic Damage

Type of building	Vibration Velocity in mm/s (Peak) Measured at the Foundation	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed	50 mm/s	
Unreinforced	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note: Values applicable at building foundation

Noise and vibration from blasting

The assessment of noise and vibration impacts associated with blasting during the construction phase has used DERM's ecoaccess guideline, *Noise and Vibration from Blasting* (2006). These guidelines provide an assessment criterion for blasting noise and vibration as follows:

1) Noise

Blasting activities must be carried out in such a manner that if blasting noise should propagate to a noise sensitive place, then the air blast overpressure:

a) must be not more than 115 dB (linear) peak for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and

b) must not exceed 120 dB (linear) peak for any blast.

2) Vibration

Blasting operations must be carried out in such a manner that if ground vibration should propagate to a noise sensitive place, the ground borne vibration:

a) must not exceed a peak particle velocity of 5 mm per second for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and

b) must not exceed a peak particle velocity of 10 mm per second for any blast.

3) Times of blasting

Blasting should generally only be permitted during the hours of 9 am to 3 pm, Monday to Friday, and from 9 am to 1 pm on Saturdays. Blasting should not generally take place on Sundays or public holidays. Blasting outside these recommended times should be approved only where:

a) blasting during the preferred times is clearly impracticable (in such situations blasts should be limited in number and stricter airblast overpressure and ground vibration limits should apply); or

b) there is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

Airblast overpressure levels received at a sensitive receptor from a blast are a function of several factors such as the charge mass and distance from the blast; burden depth; stemming height and meteorology.

Ground vibration experienced at a sensitive location from a blast is a function of several factors including the charge mass of explosive per hole, the distance from the blast and ground transmission characteristics. An approximation of the ground vibration variation with distance from the blast is provided by the following equation:

$$PPV = k\left(\frac{D}{\sqrt{m}}\right)^{e}$$

Where: PPV = peak particle velocity (mm/s)
m = charge mass per hole (kg)
D = distance from blast (m)
e = site exponent – a value of -1.6 is usually appropriate for coal overburden
k = site constant – a value between 800 and 1600 is the likely range

4.7.1. DESCRIPTION OF ENVIRONMENTAL VALUES

4.7.1.1. Existing environment

The nearest sensitive receptors to the proposed pipeline route and the existing noise and vibration environment for the project area are described as follows.

Sensitive receptors

Sensitive receptors are at locations which have the potential to be impacted by noise and vibration from the project. Noise and vibration sensitive receptors within the project area include:

- Residential dwellings;
- Educational facilities (e.g. schools, kindergartens, child care centres, and schools);
- Medical institutions (e.g. hospitals and surgeries);
- Public parks and recreational areas; and
- Religious buildings (e.g. churches).

Within a 1 km buffer, either side of the proposed pipeline route, 119 residential dwellings have been identified. Only two houses are located within 100 m of the ROW at AB398 (approximately 77 m from the proposed pipeline route) and AB440 (approximately 92 m from the proposed pipeline route) as presented in **Map series 8**, **Volume 2**.

In addition, the following facilities have been identified within 1 km either side of the proposed pipeline route near AB468:

- One police station;
- One library;
- Mount Larcom Ambulance Station; and
- Mount Larcom State School.

Sensitive receptors are shown on **Map series 8**, **Volume 2**.

Existing noise and vibration environment

Existing environmental values to be protected under the EPP (Noise) include the health and wellbeing of the residents including the ability to sleep.

Major existing noise sources along the proposed pipeline route consist of the Main North Coast Railway Line and the Bruce Highway. Other typical rural noise sources include occasional light aircraft, tractors and light vehicles. Several mining tenements including Xstrata Coal Queensland Pty Ltd, Peabody (Burton Coal) Pty Ltd, Vale Australia Pty Ltd, Coppabella Coal Pty Ltd, Marlborough Nickel Pty Ltd and Cement Australia are located within 200 m of the proposed pipeline route. In some areas along the proposed pipeline route, mining activities are audible at the sensitive receptors.

Vibration sources including roads, railway line and mining activities identified along the proposed pipeline route are not likely to cause perceivable vibration levels at the sensitive receptors therefore no baseline vibration monitoring was carried out for the project.

Background noise monitoring

Ambient noise levels were measured at five representative locations along the proposed pipeline route to provide information on the current noise environment prior to the commencement of the project construction activities. These locations were selected to indicate existing noise levels at a variety of environments along the proposed pipeline route and are identified on **Map series 8, Volume 2**.

Site visits and unattended noise monitoring were undertaken from 1 to 9 August 2011 (referred to as the noise monitoring period). During the site visit, typical noise sources and levels were observed.

Weather conditions during the noise monitoring period consisted of clear skies, calm to moderate breezes, and no rainfall. Monitoring period results are presented in **Table 4-60** and continuous noise profiles for each location are shown in **Figure 4-12** to **Figure 4-16**.

Table 4-60: Summary of unattended environmental noise monitoring descriptors

Location	Day			Evening			Night		
	L_{A10} 15 min dB(A)	L_{Aeq} 15 min dB(A)	L_{A90} 15 min dB(A)	L_{A10} 15 min dB(A)	L_{Aeq} 15 min dB(A)	L_{A90} 15 min dB(A)	L_{A10} 15 min dB(A)	L_{Aeq} 15 min dB(A)	L_{A90} 15 min dB(A)
Location 5 – Lot 4CP903281	51	49	35	40	38	28	41	39	29
Location 4 – Lot 2RP626607	42	41	28	28	30	22	26	27	20
Location 3 – Lot 2RP611042	51	49	35	46	47	38	39	39	27
Location 2 – Lot 4RP600951	56	53	43	60	56	39	59	55	33
Location 1 - Lot 4RP614012	50	47	39	45	42	34	49	45	33

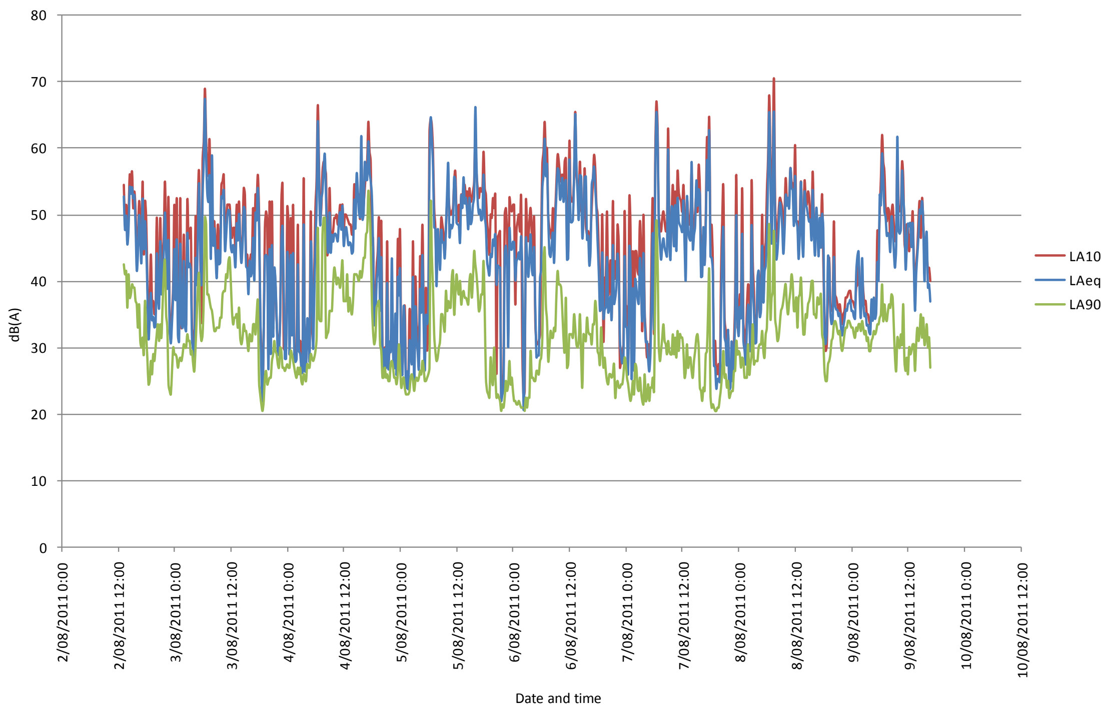


Figure 4-12: Continuous noise traces from noise monitoring conducted between 1 and 9 August 2011 at Location 5

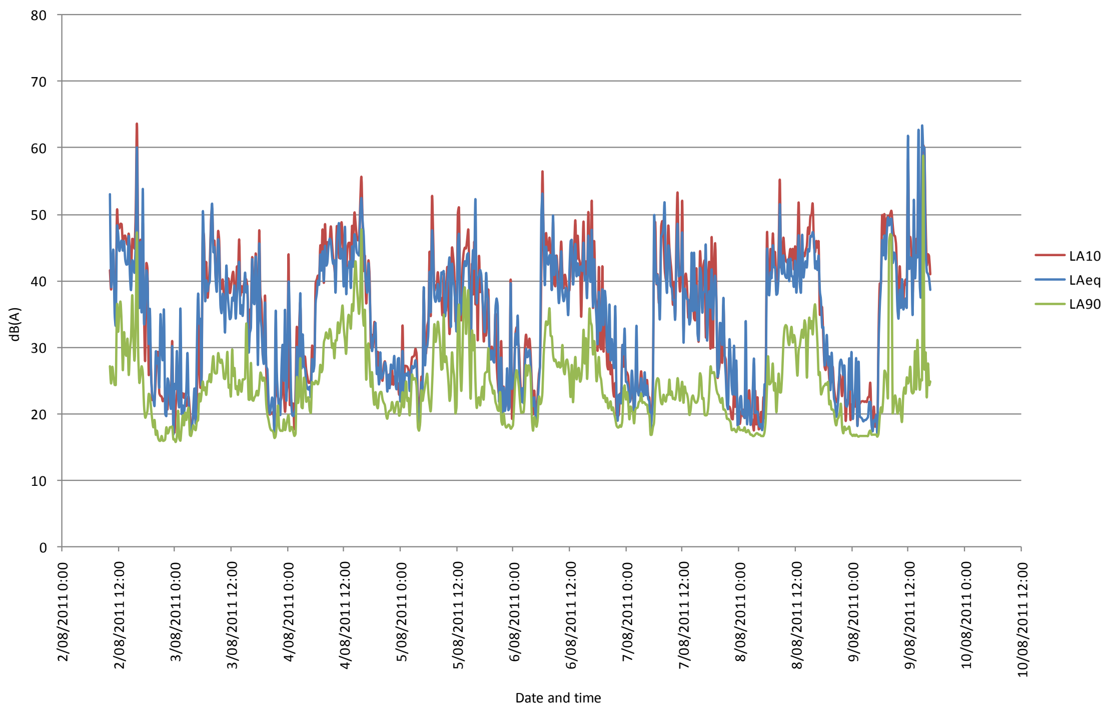


Figure 4-13: Continuous noise traces from noise monitoring conducted between 1 and 9 August 2011 at Location 4

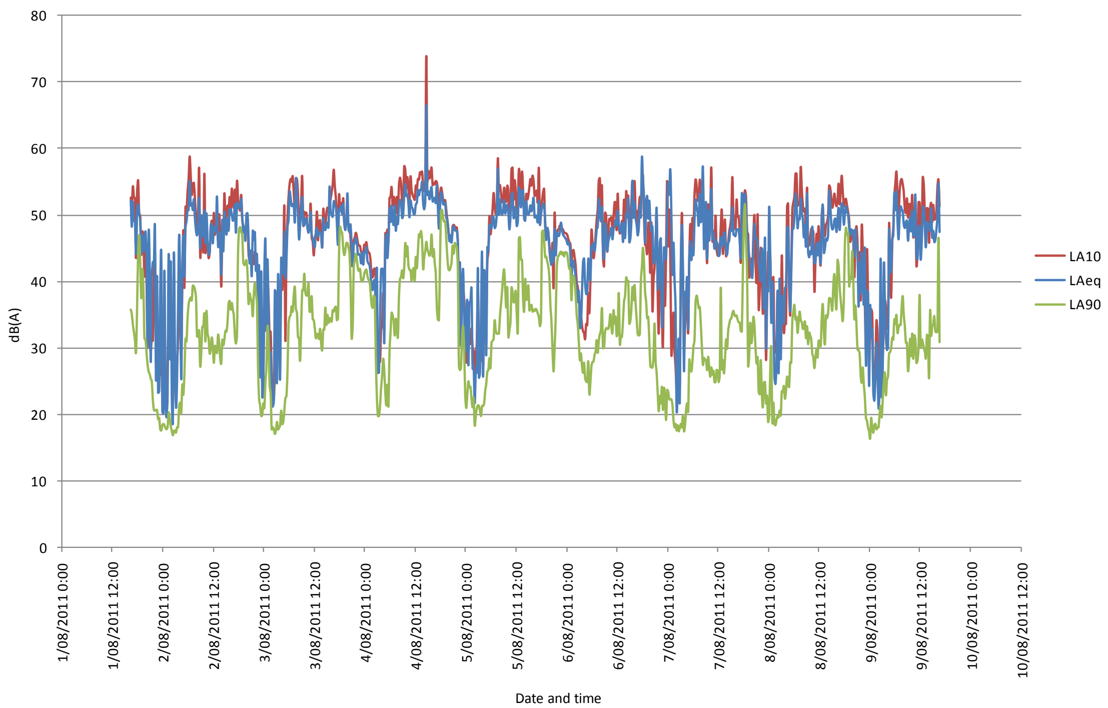


Figure 4-14: Continuous noise traces from noise monitoring conducted between 1 and 9 August 2011 at Location 3

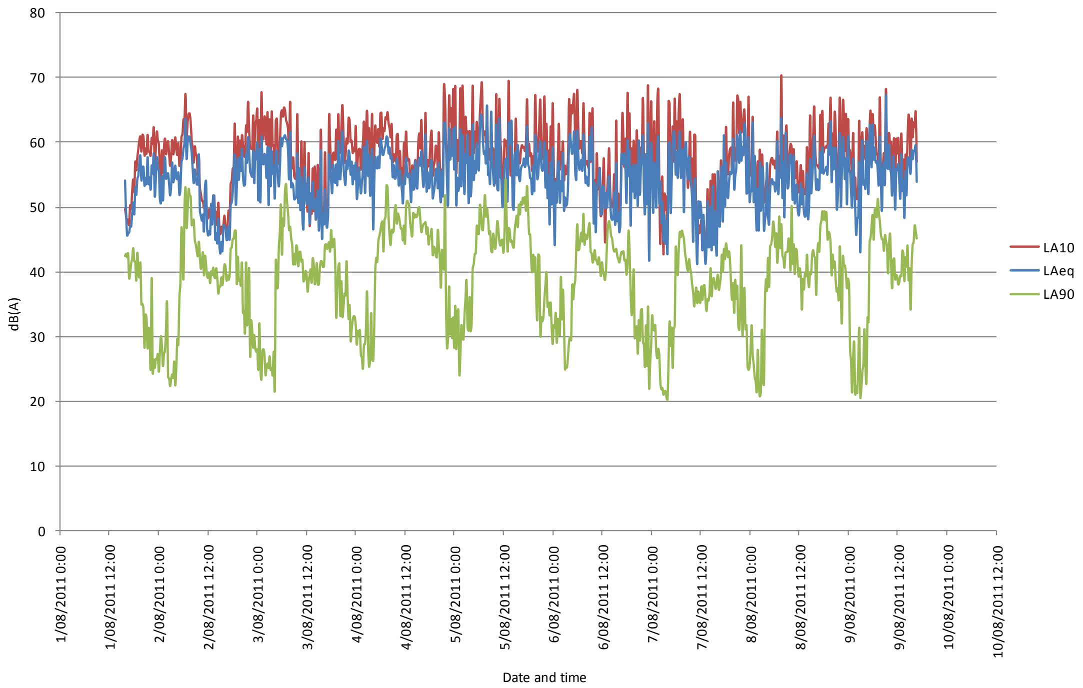


Figure 4-15: Continuous noise traces from noise monitoring conducted between 1 and 9 August 2011 at Location 2

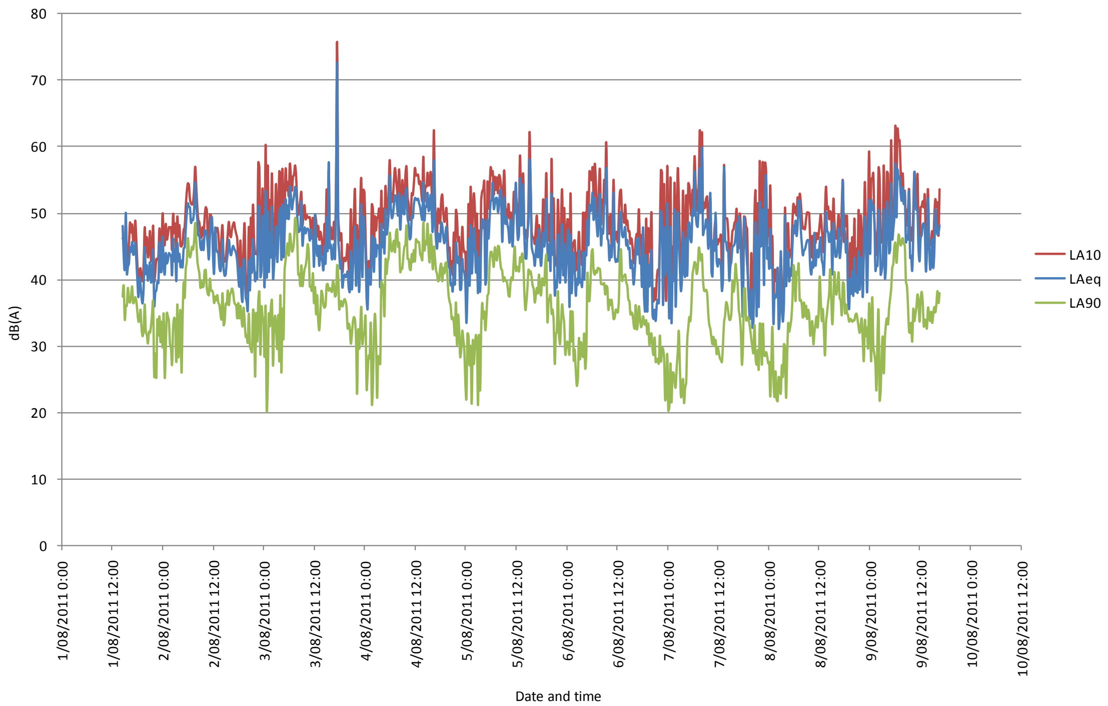


Figure 4-16: Continuous noise traces from noise monitoring conducted between 1 and 9 August 2011 at Location 1

In general, the noise environment at locations in the vicinity of the Bruce Highway and Main North Coast Railway Line is influenced by noise from rail and road traffic noise. The environment at isolated rural residences has very low background noise levels with attended monitoring showing L_{A90} noise levels below 30 dB(A) during daytime hours. Observations during the monitoring period at each location are presented as follows:

- Location 5 – a rural residential site located approximately 10 km northeast of the Millenium and Poitrel mines and 5 km west of the Millenium coal loading facility (off the Goonyella branch railway line). The primary noise sources at this site are general farm noise source such as pumps, dogs and machinery, in addition to operational noise from nearby coal mines and regular trains passing on the Goonyella branch railway line under adverse meteorological conditions. During the monitoring period the average daytime $L_{Aeq(15\ minute)}$ noise level was 49 dB(A), whilst background daytime $L_{A90(15\ minute)}$ noise level was 35 dB(A). Night time average $L_{A90(15\ minute)}$ noise level was 29 dB(A).
- Location 4 – an isolated rural residence; noise monitoring at this site showed very low background noise levels, with occasional peaks from on site rural noise sources such as pumps, light aircraft and vehicles. Other noise sources are generally typical rural farm noise, including cattle, pigs, birds and wind. During the daytime hours, average $L_{Aeq(15\ minutes)}$ level was 41 dB(A), whilst average $L_{A90(15\ minute)}$ background noise levels during daytime hours was 28 dB(A). Average night time $L_{A90(15minute)}$ noise level was 20 dB(A), highlighting the very quiet nature of this location.
- Location 3 – situated in a semi-rural area on Boongary Road, in the vicinity of Gracemere, south west of Rockhampton. There are a group of residences in this area, which are all influenced primarily by frequent traffic noise from light and heavy vehicles moving along Boongary Road. During the monitoring period the average daytime $L_{Aeq(15\ minute)}$ and $L_{A90(15\ minute)}$ levels were approximately 49 dB(A) and 35 dB(A), respectively. Traffic during night time hours is considerably lower and consequently night time noise levels are very low at this site, with an average $L_{A90(15\ minute)}$ level of 27 dB(A).
- Location 2 – located adjacent to Bruce Highway, 9 km north of the village of Bajool, and is one of two residential properties located close to the Main North Coast Line and the Bruce Highway. The noise environment at this location is dominated by noise from these sources, in particular from coal trains and heavy vehicles. Average daytime $L_{Aeq(15minute)}$ noise level was 53 dB(A), whilst the average daytime $L_{A90(15\ minute)}$ noise level was 43 dB(A). Night time average $L_{A90\ (15\ minute)}$ noise level was 33 dB(A).
- Location 1 – a rural residence located on Raglan Station Road, on the northern outskirts of the Ambrose township. The noise environment at this site is influenced by traffic noise from the Bruce Highway and rail pass-bys along the main North

Coast Line. The background $L_{A90(15\ minute)}$ noise levels were influenced by distant traffic on the Bruce Highway. During the monitoring period the average daytime, evening and night time $L_{A90(15\ minute)}$ noise levels were 39 dB(A), 34 dB(A) and 33 dB(A), respectively.

4.7.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

4.7.2.1. Construction noise

Construction of the project is expected to occur for a period of approximately 15 months with activities progressing from one end of the proposed pipeline route to the other. Construction hours will be restricted to the daytime period (6.00 am to 6.00 pm) with the exception of hydrostatic testing and a few nights at each location where a HDD of a watercourse is proposed.

There are several construction stages and the total duration of construction activity at any one location along the proposed pipeline route is expected to be of limited duration with intermittent activity.

Construction of the pipeline will require a ROW to be cleared, trenched, backfilled and rehabilitated. During construction, the key activities with potential to generate noise include:

- Clear and grade.
- Stringing and welding.
- Trenching.
- Lowering-in and backfilling.
- HDD.
- Clean-up, restoration and rehabilitation.

The machinery and equipment associated with pipeline construction include:

- Flat bed articulated trucks or extendable tri-axle trailers to transport pipes to site;
- Tip trucks to transport bedding sand on site and excavated burden off site;
- Cranes and side booms for pipe laying;
- Excavation machinery, including excavators/trenching machines;
- Bulldozers;
- Mobile welding plant;
- Mobile crusher;

- Generator sets to supply power for HDD and the temporary workers' accommodation camps; and
- Light trucks/utility vehicles.

Noise levels from construction of the pipeline are estimated at sensitive receptors based on the construction information and the approximate sound power levels for this equipment (measured at the noise source), as specified in **Table 4-61**. Sound pressure levels at a range of distances from major construction noise sources are also presented in **Table 4-61**. These values are conservative estimates, based on geometric spreading only. Where absorptive surfaces and structural or topographical barriers are in place, the predicted value will be lower.

Table 4-61: Typical A-weighted sound power levels from site equipment and estimated sound pressure levels at a distance from the source

Plant	Average Measured LAeq Sound Power Level dB(A)	Acoustic Quality Objective LAeq, adj 1hr dB(A)	Estimated LAeq sound pressure level at a distance from the source, in dB(A)Table Heading				
			20 m	50 m	100 m	200 m	400 m
Tri-axle trailer	90	50 (daytime)	56	48	42	36	30
Tip Truck	94		60	52	46	40	34
Crane	98		64	56	50	44	38
Excavator/Trenching machine	100		66	58	52	46	40
Dozer/Crusher	104		70	62	56	50	44
Light truck/ utility vehicles	90		56	48	42	36	30
Generator set	100	40 (Night time)#	66	58	52	46	40

Assumed 10 dB(A) reduction between outdoor and indoor with slightly open window

Based on the use of a range of construction machinery such as dozers, excavators and trenching machines, daytime construction noise levels may exceed the project goal at seven noise sensitive receptors located less than 200 m from the construction. For the night time HDD activity currently proposed at Fitzroy River, parts of the Isaac River and Raglan Creek (subject to geotechnical suitability), the nearest sensitive receptor is located approximately 800 m away and the noise levels from the HDD activity will meet the project goal at all noise sensitive receptors.

However, in practice, exceedances will be of short duration since construction will move from one area to another as the project progresses and the total duration of construction activity at any location along the pipeline would be of limited duration. Vegetation and terrain changes will also serve to further reduce noise intensity levels.

During commissioning of the pipeline, air will be released through valves during pigging operations associated with the introduction of gas. The noise impact from air release during this would be minimal as this activity is of short duration and site-specific as it is limited to valves along the pipeline route.

Ongoing consultation with affected landholders during construction of the pipeline will help to mitigate potential noise impacts. Noise control measures will also be implemented for the duration of construction period. Prior to the commencement of site works, nearby noise sensitive receptors (residents) will be informed of the upcoming activities and likely duration. A complaints register will also be maintained with complaints addressed in a timely manner.

All mechanical plant will be adequately maintained and operated in accordance with manufacturers' specifications. Tailgates on trucks will be securely closed to avoid unnecessary ―clanging" noise particularly during movement of empty trucks. When pneumatic equipment is used, acoustically-treated compressors will be selected.

Regular inspections and maintenance of both stationary and mobile plant and equipment will be undertaken and equipment which is not being utilised as part of the work will not be left standing with engines running for extended periods.

4.7.2.2. Transport

Materials are likely to be delivered and collected by road only, with trucks accessing the construction ROW via highways and local roads. During construction, a worse case estimate of heavy traffic movements is 64 truck loads per day (32 truck loads in each direction) to the active construction area. This frequency represents minimal risk of adverse impacts on the ambient noise level. Traffic management will form part of the project EMP and the TMP (refer to **Section 4.3** and **Chapter 5**).

4.7.2.3. Operational noise

Noise would not be generated from normal operation of the project. However, when venting of the pipeline is required (e.g. emergency release), a very loud, high-pitched noise would be generated. This would only occur in an emergency and would be a rare event. If for any reason venting was required at any other times (e.g. maintenance), local residents, landholders and affected industries would be notified in advance.

4.7.2.4. Vibration

It is difficult to predict ground vibration levels accurately due to the dependence of vibration transmissibility on soil type and intervening geology. A general method to minimise ground vibration impact is to maintain an adequate buffer distance between the vibration source and receptor.

Generally, a buffer distance of 20 m is recommended for construction work that does not involve blasting and piling. No piling will be required for the project. In any event, as construction activities will be greater than this distance from any sensitive receptor, construction vibratory impact is likely to be minimal.

There are unlikely to be any operational vibration sources associated with the project. Hence, no assessment of this issue has been undertaken.

4.7.2.5. Effects of noise on local wildlife/fauna

The amount of information available on the effects of general construction noise on Australian wildlife/fauna is relatively sparse. However, extensive studies undertaken in the US suggest that long term exposure of fauna to noise may have a minimal effect on the behaviour and the habitat of some wildlife (Larkin *et al* 1996). Noise affects wildlife differently from humans and the effects can vary from serious to non-existent in different species and situations. Direct physiological effects of noise on fauna are difficult to measure in the field and many of the impacts are observed by behavioural changes. For repeated construction noise, some form of habituation may occur and the animals may simply maintain activities in their natural habitat after an initial period of acclimatisation. It is only when this does not occur and when the noise causes a decrease of survivability and reproduction as a result of a retreat away from favourable habitats due to the noise that an issue of concern may arise.

Another potential noise impact is interference with communication between wildlife when high noise levels are sustained over a long period. This is unlikely to occur due to the behavioural modifications outlined above (human activities will tend to cause relocation).

It is generally unlikely that the noise due to the construction of the pipeline or subsequent operational activities will have a lasting or major impact on the native fauna.

4.7.2.6. Blasting

Blasting may be required to loosen in-situ rock in areas along the pipeline.

An analysis of where rock blasting will occur will be confirmed during the detailed design and final route section stage. The charge mass of explosive required per hole per blast will be very limited as rock and overburden of only up to 2 m deep and 1.6 m wide will need to be loosened.

Blasting from the construction along the proposed pipeline route is not likely to cause perceivable vibration levels at the sensitive receptors and will not exceed the airblast overpressure and ground vibration criteria.

The blasting levels and times provided within the DERM Ecoaccess guideline, *Noise and Vibration from Blasting* (2006) will need to be considered for blasting undertaken as part of construction activities.

Should blasting be required, a condition survey will be conducted on any landholders properties within 100 m of where blasting is to occur Any blasting will be carried out in accordance with current practice standards with particular reference to AS 2187.

4.7.3. SUMMARY

Construction noise impacts of the proposed pipeline route are expected to exceed the project goal at approximately seven noise sensitive receptors (within 200 m) but the impact is likely to be minimal considering activity will only occur during the day for the majority of the works and will be short term at any one location.

Noise control strategies will focus on minimising possible short term noise nuisance as a result of some noisy construction activities to a limited number of noise sensitive receptors in close proximity to the pipeline. These strategies have been incorporated into the EMP (refer **Chapter 5**), and will be implemented by the construction contractor.

The project commitments outlined with regards to the management of noise and vibration are shown in **Table 4-62**.

Table 4-62: Project commitments for noise and vibration

Issue	Commitment
Noise and Vibration	▪ The contractor will liaise with landholders to advise on the construction schedule and construction works through their respective landholdings and the likely duration of potentially noisy activities, ▪ A complaints register will be maintained and complaints will be addressed in a timely manner. ▪ Vehicles, plant and equipment will be maintained in accordance with manufacturers' requirements. ▪ The speed of construction vehicles accessing the ROW will be limited. ▪ With the exception of HDD and hydrotesting, construction activities will generally be limited to between the hours of 6.00am and 6.00pm ▪ Any blasting will be carried out in accordance with current practice standards with particular reference to AS 2187. ▪ Should blasting be required, a condition survey will be conducted on any landholders properties within 100 m of where blasting is to occur.

4.8. ECOLOGY

This section describes the terrestrial and aquatic flora and fauna and associated ecological values relevant to the project and project area. This section also describes the potential impacts and mitigation measures associated with the identified ecological values.

This section is divided into the following sections:

- Terrestrial flora;
- Terrestrial fauna; and
- Aquatic flora and fauna.

The *Environmental Assessment Report (Flora) for the Proposed Arrow Bowen Pipeline* is presented in **Appendix A4.3**, **Volume 3,** the *Terrestrial Fauna Assessment* is presented in **Appendix A4.4**, **Volume 3** and the *Aquatic Ecology Assessment* is presented in **Appendix A4.13**, **Volume 3**. The results of these assessments have been summarised in this section.

Legislation, policies and guidelines

The assessment of ecological values associated with the project is based on relevant legislation, policies and guidelines, the key ones of which are shown in **Table 4-63**.

Table 4-63: Legislation, policies and guidelines for ecology

Legislation, policies and guidelines	Relevance
Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	▪ Provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places defined in the Act as matters of national environmental significance (NES). Refer to **Section 1.5.1.1**.
Environmental Protection Act 1994 (EP Act)	▪ Protects Queensland's environment by encouraging ecologically sustainable development. ▪ Environmental conditions of particular relevance to the ecological assessment are Environmentally Sensitive Areas (ESA) as defined in the Environmental Protection Regulation 2008. Refer to **Section 1.5.1.2**.
Fisheries Act 1994 (Fisheries Act) and *Fisheries Regulation 2008* (Fisheries Regulation)	▪ Regulates the management, use, development and protection of fisheries resources and fish habitats and the management of aquaculture activities. The disturbance of marine plants (mangroves) is also administered. Refer to **Section 1.5.1.2**.
Land Protection (Pest and Stock Route Management) Act 2002 (LP Act)	▪ Provides for pest and plant management in Queensland under three classes of declared pests. Refer to **Section 1.5.1.2**.
Nature Conservation Act 1992 (NC Act)	▪ Identifies objectives and principles to conserve biological diversity, ecologically sustainable use of wildlife and ecologically sustainable development. Refer to **Section 1.5.1.2**.
Petroleum and Gas (Production and Safety) Act 2004 (P&G Act)	▪ The P&G Act aims to facilitate and regulate the carrying out of responsible petroleum activities and the development of a safe, efficient and viable petroleum and fuel gas industry ▪ Approval under the P&G Act exempts some pipeline activities from approval under other Acts, for example vegetation clearing under the VM Act. Exemptions only apply if works are conducted for activities authorised under the licence within the specified licence area. Refer to **Section 1.5.1.2**.
Vegetation Management Act 1999 (VM Act)	▪ Provides for the conservation of native vegetation in Queensland and regulates the clearing of mapped remnant vegetation and high value regrowth vegetation on freehold and leasehold land. Refer to **Section 1.5.1.2**.

Legislation, policies and guidelines	Relevance
Queensland Government Environmental Offsets Policy	▪ Provides an integrated, consistent and transparent framework for applying environmental offsets in Queensland. As vegetation clearing for a petroleum activity is exempt from assessment under the VM Act, it is likely that the project is also exempt from offset requirements under the Policy for Vegetation Management Offsets. However, offsets for clearing of Endangered and Of Concern REs are also required under the recently introduced Biodiversity Offset Policy. Refer to **Section 1.5.2.1**.

Methodology

Terrestrial flora

The assessment of terrestrial flora is generally based on a desktop assessment within a 10 km project area, centred on the proposed pipeline route (i.e. 5 km buffer either side), including:

- A review of Queensland Herbarium RE mapping in conjunction with an examination of aerial photography;
- A review of the ESA mapping provided by DERM;
- A review of species data provided by Queensland Herbarium Herbrecs, DERM Wildnet and EPBC Protected Matters Search, (sourced in December 2010); and
- A review of wetland mapping provided by DERM (2009).

The density of flora and fauna specimens collated from Queensland Herbarium, Queensland Museum and Wildnet databases was significantly lower in the northwest half of the proposed pipeline route (i.e. west of the Broadsound Range from AB0 to AB310) than in the south-eastern half. To compensate for the discrepancy in specimen density, a project area of 20 km centred on the proposed pipeline route (10 km buffer) was utilised for flora and fauna database searches west of the Broadsound Range, while the standard 5 km buffer was used in the section east of the range.

The field surveys were conducted from 14 June to 4 August 2011 (winter survey) and 29 August to 11 September 2011 (spring survey) to account for different seasonal conditions. The field surveys concentrated on the proposed 30 m ROW and included:

- An investigation of the presence / absence or likely presence / absence of Endangered, Vulnerable and Near Threatened (EVNT) flora species, as identified on the State and Commonwealth database lists;

- The ground-truthing of 392 sites within the proposed ROW or potential alternative ROW alignments; and
- An observation on the wider environment surrounding each site so that the potential impacts associated with the proposed clearing could be discussed in local, state and Commonwealth contexts.

Terrestrial fauna

The assessment of terrestrial fauna is generally based on a desktop assessment within a 10 km project area, centred on the proposed pipeline route (i.e. 5 km buffer), including:

- A review of Queensland Herbarium RE mapping in conjunction with an examination of aerial photography; and
- A review of DERM Wildnet species data, EPBC Protected Matters Search and Queensland Museum Zoology data.

An expanded project area of 20 km buffer to the ROW was utilised to capture sufficient fauna data.

The field survey was conducted from 14 June to 3 July 2011 (winter survey) and 5 September to 20 September 2011 (spring survey) to account for different seasonal conditions. The field surveys concentrated on the proposed 30 m ROW.

The field surveys included:

- A fauna habitat assessment including the recording of important habitat features based on the BioCondition Assessment Methodology;
- Ultrasonic bat detectors used in conjunction with harp trapping to census microchiropteran bat fauna;
- A diurnal and nocturnal census including visual inspections and identification through calls for amphibian surveys;
- A pitfall trapping survey for reptiles;
- A survey of birds by sight and vocalisations in the morning, and listening for vocalisations, broadcasting the target species call and spotlighting at of owls and other nocturnal birds at night for bird surveys; and
- An elliot trapping survey for mammals.

Aquatic ecology

The assessment of aquatic ecology is based on a desktop assessment within a 20 km project area centred on the proposed pipeline route (10 km buffer) for aquatic fauna, and a 10 km project area, centred on the proposed pipeline route (five km buffer) for aquatic flora including:

- A review of DERM WildNet species data, Directory of Important Wetlands and DSEWPC Protected Matters Search;
- A review of Biosecurity Queensland's Annual Pest Distribution Survey data and predictive maps;
- A review of the Queensland Government's Environment and Resource Management Wetland Info data;
- A review of records published in scientific journals and results of local environmental studies, including studies prepared by consultants, local government authorities, biological organisations, universities and other sources; and
- A literature review of all threatened species likely to occur in the project area.

The field survey was conducted from 12 September to 24 September 2011 (spring survey). Suitable sampling sites were concentrated on the 30 m ROW and were selected based upon desktop review of relevant database searches and existing data and compared against the *Water Crossing Information for Arrow Bowen Gas Pipeline* (refer to **Appendix A4.13**, **Volume 3**).

The field survey included:

- An analysis of water quality at each of the freshwater sites;
- A survey of estuarine and freshwater fish communities; and
- A visual inspection of submerged or emergent aquatic water plants and macrophytes for the aquatic habitat and flora assessment.

4.8.1. DESCRIPTION OF ENVIRONMENTAL VALUES

4.8.1.1. Terrestrial flora

Environmentally Sensitive Areas

ESAs and their category are identified in **Section 4.2.1.7**.

Areas protected under the NC Act that are within 5 km of the proposed pipeline route are listed in **Table 4-64**. The ROW does not traverse any protected area estate, but lies within 5 km of six State Forests and four Nature Refuges. No National Parks or World Heritage

Areas occur within 5 km of the proposed pipeline route. The proposed pipeline route runs through the Burdekin, Fitzroy and Calliope catchments which flow into the Great Barrier Reef lagoon.

Table 4-64: Protected Area Estate within the project area

Estate name	Lot and plan	KP and distance from proposed pipeline route
Newlands Nature Reserve	4 SP171919	2 km west of AB0
Kemmis Creek Nature Reserve	12 WHS529	4.7 km northeast of EL0
Coolibah Nature Reserve	9 CNS42	2 km south of DL0 – DL1
Eugene State Forest	65 FTY1503	2 km north of AB302-AB304 and 2 km northeast of AB298-AB302
Develin State Forest	66 FTY1343	4.5 m southwest of AB312-AB314
Aricia State Forest	11 4FTY861	2 km north of AB334-AB339
Morinish State Forest	878 FTY842	5 km southwest of AB360-AB362
Bouldercombe State Forest	950 FTY1794	3.5 km north of AB405
Pindari Nature Reserve	181 DS631	4 km south of AB440
Mount Larcom State Forest	208 FTY1451	5 km north-northeast of AB466

Vegetation communities and Regional Ecosystems

The proposed pipeline route passes through the Brigalow Belt Bioregion (Bioregion 11). Queensland Herbarium RE mapping recognises 78 REs within project area. The ground-truthed RE‘s and examination of satellite imagery identified 30 REs within the ROW (refer to **Appendix A4.3, Volume 3**).

The proposed pipeline route is characterised by:

- Non-remnant vegetation (428.79 km or 73.8% of the proposed pipeline route), most of which is cropping and grazing land;
- High value regrowth (28.06 km or 4.78%); and
- Remnant vegetation (approximately 124 km or 21.4%) comprising of Endangered REs (0.44 km or 0.07% of the route), Of Concern REs (27.8 km or 4.79% of the route) and No Concern at Present REs (95.7 km or 16.4% of the route).

The most prominent vegetation types within the project area include No Concern at Present poplar box woodland on residual Cainozoic sand plains (33.93 km) (RE 11.5.3) and No Concern at Present ironbark woodland on fine-grained sedimentary rocks (19.33 km) (RE 11.9.9). A sequential breakdown of REs along the proposed pipeline route (including figures illustrating mapped and surveyed REs) is provided **Map series 10**, **Volume 2** and in **Appendix A4.3**, **Volume 3**.

EPBC listed communities

An EPBC Protected Matters Search identified five Endangered Ecological Communities (EECs) that may occur within or adjacent to the ROW. In March 2011, DSEWPAC listed the Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions as an EEC. According to the listing advice, this community corresponds to RE 11.3.3 only where it occurs in the Brigalow Belt South Bioregion. Since all occurrences of RE 11.3.3 in the ROW (AB110-110.04; 167.98-168.05; 238.29-238.51 and 284.18-284.29) were recorded in the Brigalow Belt North Bioregion, these areas are not considered to form part of the listed EEC and have therefore been omitted from **Table 4-65** and subsequent calculations (AECOM 2011).

The EECs, REs included in the EEC and areas of those REs within the ROW and project area are described in **Table 4-65**.

The ROW contains 33.53 ha (approximately 0.41% of the area within the project area) of remnant REs which form components of the EECs. The actual amount of clearing of EECs is likely to be less than 33.53 ha as approximately 27.2 ha of this total is RE 11.3.2 (poplar box woodland). Weeping Myall (*Acacia pendula*) woodlands EEC forms only a very small proportion of this RE and no Weeping Myall was observed during the field surveys, so it is likely that none of the 27.2 ha within the ROW contains this EEC. This would reduce the area of EEC occurring within the ROW to 6.33 ha.

Table 4-65: EPBC listed EECs and equivalent REs within the ROW and the project area

EPBC community description	EPBC Act status*	Equivalent RE	Area in ROW (ha)	Area in project area (5km buffer) (ha)	% in project area^
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	11.3.1	0.84	4044.62	0.02
		11.4.8	0	851.58	0
		11.4.9	0.50	2,069.69	0.02
		11.5.16	0	11.38	0
		11.9.1	0	537.77	0
		11.9.5	0	1,555.66	0
		11.11.14	0	602.06	0
		11.12.21	0	28.82	0
Natural grasslands of the Qld Central Highlands and the northern Fitzroy Basin	Endangered	11.3.21	0	770.52	0
		11.4.4	0	84.21	0
		11.8.11	4.99	5,397.11	0.09
		11.9.3	0	298.11	0

EPBC community description	EPBC Act status*	Equivalent RE	Area in ROW (ha)	Area in project area (5km buffer) (ha)	% in project area^
Semi-evergreen vine thickets of the Brigalow Belt	Endangered	11.3.11	0	181.82	0
		11.4.1	0	6.67	0
		11.5.15	0	106.48	0
		11.8.13	0	571.93	0
		11.11.18	0	349.55	0
Weeping Myall Woodlands (only small component of RE)	Endangered (where *A. pendula* dominates)	11.3.2	27.20#	12,617.49	0.22
Total			**33.53**	**30,085.47**	**0.35**

^ Percentage of area in 5 km buffer that lies within the 30 m proposed pipeline route.

These areas are unlikely to contain EECs

Regional Ecosystems

Based on Queensland Herbarium RE mapping, the ROW traverses 11 vegetation communities with an Endangered Biodiversity Status, including:

- 11.3.1: *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains;
- 11.3.11: Semi-evergreen vine thicket on alluvial plains;
- 11.3.21: *Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains (cracking clay soils);
- 11.4.8: *Eucalyptus cambageana* woodland to open-forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains;
- 11.4.9: *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains;
- 11.4.13: Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding;
- 11.8.13: Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks;
- 11.9.1: *Acacia harpophylla-Eucalyptus cambageana* open-forest to woodland on fine-grained sedimentary rocks;
- 11.9.5: *Acacia harpophylla* and/or *Casuarina cristata* open-forest on fine-grained sedimentary rocks;

- 11.11.14: *Acacia harpophylla* open-forest on deformed and metamorphosed sediments and interbedded volcanic; and

- 11.11.18: Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.

The field survey identified two of these REs within the ROW (11.3.1 and 11.4.9). There were 59 occurrences along the proposed pipeline route that were mapped by the Queensland Herbarium as Endangered RE or containing a proportion of Endangered RE. Field assessment surveys confirmed three occurrences of Endangered REs (two occurrences of 11.4.9 and one occurrence of 11.3.1), while 28 were identified as supporting an Of Concern RE, 11 sections were identified as supporting No Concern at Present REs, five sections contained high value regrowth and 14 sections did not contain remnant vegetation.

Based on Queensland Herbarium RE mapping, the proposed pipeline route traverses 13 vegetation communities with an Of Concern Biodiversity Status, including:

- 11.3.2: *Eucalyptus populnea* woodland on alluvial plains;

- 11.3.3: *Eucalyptus coolabah* woodland on alluvial plains;

- 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines;

- 11.3.27: Freshwater wetlands;

- 11.3.36: *Eucalyptus crebra* and/or *E. populnea* and/or *E. melanophloia* on alluvial plains. Higher terraces;

- 11.3.4: *Eucalyptus tereticornis* and/or *Eucalyptus spp*. tall woodland on alluvial plains;

- 11.3.7: *Corymbia spp*. woodland on alluvial plains;

- 11.4.2: *Eucalyptus* spp. and/or *Corymbia spp*. grassy or shrubby woodland on Cainozoic clay plains;

- 11.4.4: *Dichanthium spp*., *Astrebla spp*. grassland on Cainozoic clay plains;

- 11.8.11: Dichanthium sericeum grassland on Cainozoic igneous rocks;

- 11.9.7: *Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks;

- 11.11.10: *Eucalyptus melanophloia* woodland on deformed and metamorphosed sediments and interbedded volcanic; and

- 11.11.16: *Eucalyptus cambageana*, *Acacia harpophylla* woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands.

The field survey identified 12 Of Concern REs. Field surveys confirmed 88 of 142 occurrences that were mapped by the Queensland Herbarium as Of Concern RE or containing a proportion of Of Concern RE and identified a further seven occurrences of Of Concern previously mapped as non-remnant. One section was identified as supporting a mix of Of Concern/Endangered RE, 19 sections were identified as supporting No Concern at Present REs, 12 sections were identified as No Concern at Present/Of Concern mixed REs, two sections were found to support high value regrowth and twenty sections did not contain remnant vegetation. One RE (11.7.1x1 *Acacia harpophylla* and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *E. microcarpa* woodland on lower scarp slopes on lateritic duricrust) was recorded during the field surveys, but was not mapped by DERM.

Based on Queensland Herbarium RE mapping, the proposed pipeline route traverses 18 vegetation communities with a No Concern at Present Biodiversity Status, including:

- 11.1.1: *Sporobolus virginicus* grassland on marine clay plains;
- 11.1.4: Mangrove forest/woodland on marine clay plains;
- 11.3.26: *Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains;
- 11.5.3: *Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* on Cainozoic sand plains/remnant surfaces;
- 11.5.8: *Melaleuca spp*., *Eucalyptus crebra*, *Corymbia intermedia* woodland on Cainozoic sand plains/remnant surfaces;
- 11.5.9: *Eucalyptus crebra* and other *Eucalyptus spp*. and *Corymbia spp*. woodland on Cainozoic sand plains/remnant surfaces;
- 11.5.12: *Corymbia clarksoniana* woodland and other *Corymbia spp*. and *Eucalyptus spp*. on Cainozoic sand plains/remnant surfaces;
- 11.7.2: *Acacia spp*. woodland on Cainozoic lateritic duricrust. Scarp retreat zone;
- 11.8.5: *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks;
- 11.9.2: *Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks;
- 11.9.9: *Eucalyptus crebra* woodland on fine-grained sedimentary rocks;
- 11.10.12: *Eucalyptus populnea* woodland on medium to coarse-grained sedimentary rocks;

- 11.10.4: *Eucalyptus decorticans*, *Lysicarpus angustifolius* +/- *Eucalyptus spp*., *Corymbia spp., Acacia spp*. woodland on coarse-grained sedimentary rocks. Crests and scarps;
- 11.1.1: *Sporobolus virginicus* grassland on marine clay plains;
- 11.1.4: Mangrove forest/woodland on marine clay plains;
- 11.11.15: *Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanic;
- 11.12.1: *Eucalyptus crebra* woodland on igneous rocks; and
- 11.12.2: *Eucalyptus melanophloia* woodland on igneous rocks.

Field surveys confirmed 104 of 154 of occurrences that were mapped by the Queensland Herbarium as No Concern at Present RE or containing a proportion of No Concern at Present RE and identified a further 13 occurrences of No Concern at Present RE previously mapped as non-remnant. Of the remainder, 17 sections were identified as supporting an Of Concern RE, 12 sections were identified as No Concern at Present/Of Concern RE, six sections were identified as supporting high value regrowth and 15 sections did not contain remnant vegetation.

Threshold and Critically Limited REs

The Queensland vegetation and biodiversity offset policies defined two further categories of RE with conservation significance:

- Critically Limited REs that have a remnant extent below 5% of their pre-clearing extent and are less than 500 ha in total; or have a remnant extent less than 200 ha; or are at risk of the remnant extent falling below 200 ha; and
- Threshold REs that have a remnant extent near the threshold percentage for their conservation status (i.e. 10% or 30% of their pre-clearing extent).

Critically Limited and Threshold REs are listed in the Queensland vegetation and biodiversity offset policies. No Critically Limited REs are mapped by DERM within the study area. Field surveys did not record any of these REs. No Threshold REs are mapped by DERM within the proposed ROW. One Threshold RE is mapped within the project area (RE 11.5.15 – semi-evergreen vine thicket on Cainozoic sand plains-remnant). No evidence of this RE was detected during field surveys.

Regrowth vegetation

Regulated regrowth vegetation includes the following:

- Areas mapped by DERM as high-value regrowth (HVR) vegetation of Endangered, Of Concern and Least Concern REs, and have not been cleared since 31 December 1989;
- Areas of native woody vegetation within 50 m of a regrowth watercourse identified by DERM as a priority Great Barrier Reef catchment; and
- Areas mapped as a category C area on a Property Map of Assessable Vegetation (PMAV).

A summary of the areas of high value regrowth vegetation within the ROW and project area is provided in **Table 4-66**.

Table 4-66: High value regrowth vegetation within the ROW and project area

Regrowth status*	Area in ROW (ha)	Area in project area (5km buffer) (ha)	% in project area~
Endangered	19.59	11,271.55	0.17
Of Concern	24.83	15,713.17	0.22
Least Concern	39.78	11,072.47	0.25
Total regrowth	**84.2**	**38,057.19**	**0.64**

*Status under Queensland VM Act: E=Endangered, OC=Of Concern, LC=Least Concern
~Percentage of areas in 5km buffer that lies within the ROW.

Essential habitat

Essential habitat for *Eucalyptus raveretiana* (black ironbox), listed as Vulnerable under both the NC Act and the EPBC Act, occurs within the ROW and project area. The ROW contains 0.7 ha of essential habitat and is mapped by DERM near the crossing of Limestone Creek (AB367-370). This species occurs along rivers, creeks and watercourses on clay and loam soils. The distribution of the species overlaps with three EPBC listed EECs (Brigalow, semi-evergreen vine thickets and natural grasslands of the Queensland central highlands and the northern Fitzroy basin). The field surveys recorded black ironbox from one occurrence of essential habitat (AB371.2-371.3).

Endangered, Vulnerable and Near Threatened flora

A search of the Queensland Herbarium, Wildnet and EPBC databases identified 33 flora species within the project area of the proposed pipeline route as summarised in **Table 4-67**. There were no records of EVNT within the ROW.

Table 4-67: EVNT flora species recorded within the project area

Scientific name	Status* EPBC	Status* NC Act	Recorded within the route during field surveys	Source~
Bertya pedicellata	-	NT	-	QH, W
Bosistoa transversa (syn. *B. selwynii*)	V	-	-	EPBC
Capparis humistrata	-	E	-	QH, W
Cerbera dumicola	-	NT	Yes	QH, W
Corymbia xanthope	V	V	-	W
Cossinia australiana	E	E	-	EPBC
Cupaniopsis shirleyana	V	V	-	EPBC
Cycas megacarpa	E	E	-	QH, W
Cycas ophiolitica	E	E	-	EPBC
Cyperus clarus	-	V	-	QH
Dansiea elliptica	-	NT	-	W
Desmodium macrocarpum	-	NT	Yes	QH, W
Dichanthium queenslandicum	V	V	-	QH, W
Dichanthium setosum	V	NT	-	QH, W
Digitaria porrecta	E	NT	-	EPBC
Eucalyptus raveretiana	V	V	Yes	QH, W
Euphorbia sarcostemmoides	-	V	Yes	Not recorded previously
Graptophyllum ilicifolium	V	V	-	W
Hernandia bivalvis	-	NT	-	W
Lepidium hyssopifolium	E	-	-	W
Leucopogon cuspidatus	V	-	-	EPBC
Lissanthe brevistyla	-	V	-	QH, W
Macropteranthes leiocaulis	-	NT	-	QH, W
Macrozamia serpentina	-	E	-	QH, W
Marsdenia hemiptera	-	NT	-	QH, W
Ozothamnus eriocephalus	V	V	-	QH, W
Paspalidium scabrifolium	-	NT	-	QH, W
Paspalidium udum	-	V	-	W
Pimelea leptospermoides	V	NT	-	QH, W
Pultenaea setulosa	V	V	-	QH, W

Scientific name	Status* EPBC	Status* NC Act	Recorded within the route during field surveys	Source~
Quassia bidwillii	V	V	-	EPBC
Sannantha brachypoda	-	NT	-	QH, W
Solanum elachophyllum	-	E	-	QH, W
Taeniophyllum muelleri	V	-	-	EPBC

* Status under EPBC Act and NC Act: E = Endangered; V = Vulnerable; NT = Near Threatened.
~ Source of data: QH = Queensland Herbarium; W = DERM Wildnet; EPBC = EPBC protected matters search.
Source: ‗Environmental Assessment Report (Flora) for the Proposed Arrow Bowen Gas Pipeline' (AECOM, 2011)

During the field survey, four EVNT plant species were recorded within the project area. These included:

- *Cerbera dumicola* (Near Threatened under the NC Act). This was recorded within the ROW (AB61 to 62, AB63 to 64 and AB70 to 71). This species was recorded within lancewood and bendee (*Acacia catenulata*) woodlands on lateritic ridges (RE 11.7.2 / 11.7.3);
- *Desmodium macrocarpum* (Near Threatened under the NC Act). This was recorded between AB100.2 to 100.8 in poplar box (*Eucalyptus populnea*) woodland and between AB30.8 to 31.2 in poplar gum (*Eucalyptus platyphylla*) woodland;
- *Eucalyptus raveretiana* (Vulnerable under the NC Act and the EPBC Act). This was recorded within the ROW between KP 345 to 382.4 and at four watercourse crossings containing RE 11.3.25 (AB349.2 at Two Mile Creek, AB371.2 at Limestone Creek, AB373.4 at Deep Creek and AB382.8 at Lion Creek); and
- *Euphorbia sarcostemmoides* (Vulnerable under the NC Act). This was recorded within the ROW at AB70.5. A small population of this species was found in a lancewood (*Acacia shirleyi*) community on a lateritic ridge (RE 11.7.2 / 11.7.3). This species has not been recorded in the area prior to this survey.

Wetlands

Based on DERMs referable wetland mapping and field surveys, the proposed pipeline route traverses referable wetlands containing four REs:

- 11.1.1: *Sporobolus virginicus* grassland on marine clay plains (No Concern at Present);
- 11.1.4: Mangrove forest / woodland on marine clay plains (No Concern at Present);
- 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (Of Concern); and

- 11.3.27: Freshwater wetlands (Of Concern).

The majority of wetlands observed within the proposed route route were narrow bands of fringing riparian vegetation (RE 11.3.25) along streams. Most riparian vegetation has been degraded by clearing, frequent fires, weed invasion, grazing, erosion and changes in stream hydrology (e.g. weirs, sedimentation). Some larger watercourses in the study also contain seasonal to permanent pools that support aquatic vegetation.

Non-riverine freshwater wetlands within the ROW (RE 11.3.27) were recorded at EL31.6 to EL31.9, SL7.7 to SL7.8 and SL10.8 to SL11.1. Most non-riverine freshwater wetlands within the ROW (RE 11.3.27) appeared to be ephemeral, with low abundance and diversity of aquatic vegetation. Marine wetlands containing RE 11.1.1 and 11.1.4 were associated with several tidal creeks in the southern section of the AB mainline.

Terrestrial weeds

The desktop searches of the Queensland Herbarium, DERM Wildnet and EPBC databases identified 168 introduced flora species within the project area. A number of invasive species, including Weeds of National Significance (WONS) and other introduced plants considered to pose a particular threat to biodiversity, could potentially occur in the project area.

A total of 12 declared weeds were recorded within the ROW during field surveys (refer to **Table 4-68**) including nine Class 2 weeds (three of which are WONS) and three Class 3 weeds (one of which is a WONS).

Table 4-68: Weeds recorded during field surveys

Scientific name	Common name	LP Act status*	National status~	KP of survey record
Asparagus aethiopicus	Asparagus Fern	3	-	AB419.7
Bryophyllum delagoense	Mother of Millions	2	-	AB12.3, AB399.1, AB406.3, AB465.3
Cryptostegia grandiflora	Rubber Vine	2	WONS	AB249, AB261.5, AB275.6, AB277.7, AB284.2, AB286.4, AB289.1, AB303.1, AB328.1, AB332.2, AB336.3, AB358.4, AB358.7, AB370.4, AB377.6, AB382.7, AB391.4, AB402.7, AB410.1, AB430.1, AB430.5, AB433.1, AB433.5, AB446.6, AB448.5, AB458.6, AB462.5, AB465.3
Harrisia martini	Harrisia Cactus	2	-	AB10.5, AB13.0, AB37.6, AB87.1, AB90.2, AB93.5, AB95.1, AB96.5, AB97.7, AB232.5, AB238.5, AB249.0, AB261.5, AB312.4, AB430.5, AB433.1, AB433.5, AB445.5, AB446.4, AB446.5, EL 6.2, EL18.2, SL0.5, SL12.9

Scientific name	Common name	LP Act status*	National status~	KP of survey record
Lantana camara	Lantana	3	WONS	AB50.2, AB165.5, AB280.1, AB289.1, AB358.4, AB358.7, AB370.4, AB377.6, AB387.4, AB391.4, AB399.1, AB399.8, AB402.7, AB406.3, AB413.6, AB433.5, AB445.5, AB446.4, AB458.6, AB460.6, AB465.3, AB466.6, AB469.3, AB410.4, EL6.2, EL12.8, SL17, SL19
Lantana montevidensis	Creeping Lantana	3	-	AB410.1
Opuntia stricta	Common Pest Pear	2	-	AB10.5, AB12.3, AB19.0, AB50.0, AB50.2, AB87.1, AB93.5, AB95.1, AB97.7, AB144.9, AB245.1, AB307.9, AB358.7, AB442.4, AB446.4, AB448.5, AB465.3, EL17.8, EL12.8, EL51.6, EL18.6, SL12.9, EL5.8
Opuntia tomentosa	Velvety Tree Pear	2	-	AB0.5, AB249, AB261.5, AB312.4
Parkinsonia aculeata	Parkinsonia	2	WONS	AB18.4, AB167.5
Parthenium hysterophorus	Parthenium Weed	2	WONS	AB35.3, AB37.0, AB37.2, AB58.3, AB66.5,AB68.2, AB74.9, AB75.1, AB87.1, AB110.0, AB144.9, AB160.1, AB232.5, AB261.5, AB319.7, AB332.2, AB336.3, AB349.3, DL16.8, DL18.4, EL8.3, EL12.8, EL18.2, SL7.3
Sporobolus natalensis	Giant Rat's Tail Grass	2	-	AB92.2, AB475.9, AB476.2, AB477.3, DL30
Ziziphus mauritiana	Indian jujube; Chinee Apple	2	-	AB377.6, AB406.2

* Species declared under LP Act.

~Species listed as Weeds of National Significance.

4.8.1.2. Terrestrial fauna

Fauna habitat diversity

Habitat type is a significant factor in determining the composition of the fauna species assemblage of a certain area. The habitats within and immediately surrounding the project can be assigned to five broad categories which are described in **Table 4-69**.

Table 4-69: Habitat categories

Habitat category	Habitat species	Conservation significant species
Eucalypt woodland and open forest on alluvial soils and old sand plains	Diverse and variable canopy tree assemblage, often with a well developed understorey/ shrub layer. Examples of the canopy species present include *Eucalyptus tereticornis/ camaldulensis; E. crebra; E. cambageana; E. populnea, Corymbia tessellaris* and *C. dallachyana.* The understorey often featured Acacia species.	▪ EVNT species - Square-tailed Kite, Red Goshawk, Squatter Pigeon, Glossy Black-Cockatoo, Black-chinned Honeyeater, Little Pied Bat and Greater Long-eared Bat. ▪ Migratory species – White-throated Needletail, Fork-tailed Swift and Rainbow Bee-eater; and ▪ Culturally significant species – Short-beaked Echidna and Koala.
Woodland and open forest on non-alluvial soils	Less diverse canopy assemblage and generally a structurally sparse understorey. Canopy species present were often dominated by *Eucalyptus crebra* and *E. melanophloia.*	▪ EVNT species - Square-tailed Kite, Squatter Pigeon, Black-chinned Honeyeater, Troughton's Sheathtail-bat, Little Pied Bat and Greater Long-eared Bat; ▪ Migratory species – White-throated Needletail, Fork-tailed Swift and Rainbow Bee-eater; and ▪ Culturally significant species – Short-beaked Echidna and Koala.
Brigalow communities	The ecological community Brigalow (*Acacia harpophylla* dominant or co-dominant) is listed as an Endangered Ecological Community under the EPBC Act. Where left undisturbed, the community is dominated by tall Brigalow but may include other species such as Belah (*Casuarina cristata*), some Eucalyptus species and *Brachychiton rupestris*. The understorey layer may vary from open to dense with a diverse assemblage of species possible.	▪ EVNT species – Brigalow Scaly-foot, Yakka Skink, Ornamental Snake, Dunmall's Snake, Squatter Pigeon; Glossy Black-Cockatoo and Little Pied Bat; ▪ Migratory species – White-throated Needletail, Fork-tailed Swift and Rainbow Bee-eater; and ▪ Culturally significant species – Short-beaked Echidna
Rivers and creeks (permanent and ephemeral)	Where previous disturbance has occurred diversity may be low and a weedy understorey is common outside of the immediate riparian zone. Tree species present may include: *Eucalyptus tereticornis; Melaleuca leucadendra; M. fluviatilis; M. saligna; Casuarina cunninghamiana; Alphitonia excelsa* and *Ficus opposita.*	▪ EVNT species – Square-tailed Kite, Black-chinned Honeyeater; ▪ Migratory species – Great Egret, White-bellied Sea-Eagle, Rainbow Bee-eater, Rufous Fantail, Spectacled Monarch, Black-faced Monarch; and ▪ Culturally significant species – Platypus, Short-beaked Echidna and Koala.

Habitat category	Habitat species	Conservation significant species
Grasslands	Few EVNT species occur in this habitat type; however there are areas of pasture that become inundated sporadically which could provide temporary resources for species that will utilise areas of wet rank grasses such as Australian Painted Snipe and Latham's Snipe.	▪ EVNT species – Black-necked Stork, Australian Painted Snipe, Squatter Pigeon; ▪ Migratory species – Great Egret, Cattle Egret, Latham's Snipe, White-throated Needletail, Fork-tailed Swift and Rainbow Bee-eater; ▪ Culturally significant species – Short-beaked Echidna; and ▪ Black-necked Stork, Australian Painted Snipe and Latham's Snipe will only occur during periods of inundation. These three migratory species will all occur in, or above, this habitat type at times.
Estuarine habitats	Habitats are dominated by Mangrove low forest on Quaternary estuarine deposits. *Avicennia marina* is the most common species but other trees such as *Aegiceras corniculatum, Rhizophora* spp. and *Ceriops tagal* dominate often in pure stands. There is often a shrub layer consisting of juvenile plants of the above species.	▪ EVNT species – Water Mouse, Black-necked Stork, Australian Painted Snipe; Estuarine Crocodile; and ▪ Migratory species – Great Egret, Cattle Egret, Latham's Snipe, White-throated Needletail, Fork-tailed Swift and Rainbow Bee-eater.
Acacia woodlands on rocky substrates	The woodlands are dominated by Lancewood (*Acacia shirleyi*) and Bendee (*Acacia catenulata*) in scarp retreat zones. Other *Acacia spp*. that commonly occur and occasionally dominate the tree layer include *A. rhodoxylon, A. burrowii, A. sparsiflora, A. crassa* and *A. blakei.*	▪ EVNT species – Brigalow Scaly-foot, Yakka Skink, Dunmall's Snake, and Little Pied Bat; ▪ Migratory species – White-throated Needletail, Fork-tailed Swift and Rainbow Bee-eater; and ▪ Culturally significant species – Short-beaked Echidna.

Habitat values by Regional Ecosystem

A range of fauna habitat values can be associated with specific Regional Ecosystems including, but not limited to the following:

- High densities of hollow bearing (habitat) trees;
- Prolific nectar and blossom production;
- Complex microhabitats, providing refugia for herpetofauna and small mammals; and

- Wetland habitats which provide unique foraging and breeding resources for birds and amphibians in particular.

A detailed list of the fauna habitat values listed by RE is provided in **Appendix A4.4**, **Volume 3**.

Essential habitat

Essential habitat for one fauna species, Little Pied Bat (*Chalinolobus picatus*), is found within the ROW from AB74.7 to AB76.5. The ROW contains 6.25 ha of essential habitat for Little Pied Bat, which is listed as Near Threatened under the NC Act.

According to the DERM Essential Habitat Database, the Little Pied Bat is associated with areas of dry eucalypt woodland and open forest (e.g. *Eucalyptus melanophloia, E. populnea, E. crebra, E. moluccana, E. tereticornis, Corymbia citriodora and C. tessellaris*) at altitudes from sea level to 850 m above sea level.

Fauna species (including Endangered, Vulnerable and Near Threatened)

A search of the Queensland Museum, Wildnet and EPBC databases identified 36 EVNT fauna species within 20 km of the proposed pipeline route. The winter and spring field survey confirmed the occurrence of the Cotton Pygmy Goose, Squatter Pigeon and Little Pied Bat, and the spring field survey also confirmed the occurrence of the Grey Snake, Powerful Owl, Grey Goshawk and Grey-headed Flying Fox. The database search results are summarised in **Table 4.8-8**, along with the likelihood of occurrence within the project area.

Table 4-70: Threatened species recorded in 20 km search area and likelihood of occurrence

Class	Scientific name	Common name	Status* EPBC Act	Status* NC Act	Likelihood of occurrence within project area
Amphibians	*Cyclorana verrucosa*	Rough Collared Frog	-	NT	High. This species occurs in a range of habitats throughout its distribution, including disturbed sites.
Amphibians	*Adelotus brevis*	Tusked Frog	-	V	Low. The Tusked Frog is largely confined to wetter forest types which are absent from the project site.
Birds	*Accipiter novaehollandiae*	Grey Goshawk	-	NT	Known. This species was recorded from AB275.6.
Birds	*Erythrotriorchis radiatus*	Red Goshawk	V	E	Moderate. This species may overfly the project site on occasion.
Birds	*Lophoictinia isura*	Square-tailed Kite	-	NT	High. This species occurs in a range of habitats throughout its distribution, including disturbed sites.

Class	Scientific name	Common name	Status* EPBC Act	Status* NC Act	Likelihood of occurrence within project area
Birds	*Nettapus coromandelianus*	Cotton Pygmy-goose	-	NT	Present. Recorded from farm dams and freshwater wetlands associated with the Isaac River.
Birds	*Tadorna radjah*	Radjah Shelduck	-	NT	Low. This species prefers large open wetlands which are absent from the project site.
Birds	*Aerodramus terraereginae*	Australian Swiftlet	-	NT	Moderate. This species may overfly the project site on occasion.
Birds	*Esacus magnirostris*	Beach Stone-curlew	-	V	Low. This species prefers ocean beaches and sandy estuaries, absent from the project site.
Birds	*Calyptorhynchus lathami*	Glossy Black-cockatoo	-	V	Moderate. Some areas of potential habitat are present.
Birds	*Ephippiorhynchus asiaticus*	Black-necked Stork	-	NT	Low. This species prefers large open and shallow wetlands which are absent from the project site.
Birds	*Geophaps scripta scripta*	Squatter Pigeon	V	V	Present. Recorded from multiple locations on the mainline and all laterals.
Birds	*Falco hypoleucos*	Grey Falcon	-	NT	Low. This species is a very uncommon visitor to the region.
Birds	*Haematopus fuliginosus*	Sooty Oystercatcher	-	NT	Moderate. Some areas of potential habitat are present, particularly at Raglan Creek.
Birds	*Sternula albifrons*	Little Tern	-	E	Low. This species prefers ocean beaches and sandy estuaries, absent from the project site.
Birds	*Epthianura crocea macgregori*	Yellow Chat (Dawson)	CE	E	Moderate. This species has been recorded from approximately 1.5 km north of KP449, at Twelve Mile Creek.
Birds	*Melithreptus gularis*	Black-chinned Honeyeater	-	NT	High. Preferred habitat is present on all major waterways across project site.
Birds	*Lewinia pectoralis*	Lewin's Rail	-	NT	Moderate. This species prefers densely vegetated freshwater wetlands which occur at several locations on the Isaac River.

Class	Scientific name	Common name	Status* EPBC Act	Status* NC Act	Likelihood of occurrence within project area
Birds	*Numenius madagascariensis*	Eastern Curlew	-	NT	Moderate. Some areas of potential habitat are present.
Birds	*Ninox strenua*	Powerful Owl	-	V	Present, recorded from AB469 near Mount Larcom.
Birds	*Turnix melanogaster*	Black-breasted Button-quail	V	V	Low. Preferred vine thicket habitat is absent from project site.
Mammals	*Dasyurus hallucatus*	Northern Quoll	E	C	Moderate. May occur in more extensive forested areas.
Mammals	*Taphozous australis*	Coastal Sheathtail Bat	-	V	Moderate. May occur in more extensive forested areas.
Mammals	*Macroderma gigas*	Ghost Bat	-	V	Moderate. May occur in more extensive forested areas associated with rocky escarpment.
Mammals	*Pteropus poliocephalus*	Grey-Headed Flying-Fox	V	C	High. Extensive areas of preferred habitat present.
Mammals	*Chalinolobus picatus*	Little Pied Bat	-	NT	Present.
Mammals	*Kerivoula papuensis*	Golden-tipped Bat	-	NT	Low. Only small areas of wet forest present at AB303.5 on Devlin Creek.
Reptiles	*Rheodytes leukops*	Fitzroy River Turtle	V	V	Present. Some areas of preferred habitat present on major watercourses.
Reptiles	*Crocodylus porosus*	Estuarine Crocodile	-	V	Moderate. This species may occur in estuarine habitats.
Reptiles	*Acanthophis antarcticus*	Common Death Adder	-	NT	High. Extensive areas of preferred habitat present.
Reptiles	*Denisonia maculata*	Ornamental Snake	V	V	High. Small areas of suitable habitat present, but species recorded regularly in project area.
Reptiles	*Furina dunmalli*	Dunmall's Snake	V	V	Low. Very small number of records of this species in project area. Very scarce in northern limits of distribution, which occur in project area.
Reptiles	*Paradelma orientalis*	Brigalow Scaly-foot	V	V	High. Extensive areas of preferred habitat present.

Class	Scientific name	Common name	Status* EPBC Act	Status* NC Act	Likelihood of occurrence within project area
Reptiles	*Egernia rugosa*	Yakka Skink	V	V	Moderate. May occur in more extensive forested areas.
Reptiles	*Ophioscincus cooloolensis*	-	-	NT	Low. Species is restricted to coastal sand masses.
Reptiles	*Hemiaspis damellii*	Grey Snake	-	E	Present. Recorded from a site 6 km E of AB392.

* Status under EPBC Act and NC Act: E = Endangered; V = Vulnerable; NT = Near Threatened.

Fauna species, including amphibians, reptiles, birds and mammals recorded along the proposed pipeline route during the field surveys (winter and spring) are detailed in **Appendix A4.4**, **Volume 3.** The records have been summarised as follows with the location of recorded EVNT species shown on **Map 11, Volume 2**.

In total, 17 amphibian species were recorded along the proposed pipeline route during the field surveys, none of which were near-threatened or threatened species.

In addition, 19 reptile species were recorded along the proposed pipeline route during the winter survey and an additional 12 species were recorded during the spring survey, A EVNT species, the Endangered Grey Snake (*Hemiaspis damellii*) was also recorded during the spring survey.

A total of 119 species of birds were recorded during the winter survey, with an additional 25 species recorded during the spring survey. The following species of significance were recorded during either winter or spring field surveys:

- The Squatter Pigeon (*Geophaps scripta*), listed as Vulnerable under the EPBC Act and NC Act recorded commonly across the project area;
- The Vulnerable Powerful Owl (*Ninox strenua*) recorded from a single location near Mount Larcom;
- The Near-threatened (NC Act) and migratory (EPBC Act) Australian Cotton Pygmy Goose recorded from several locations; and
- Migratory species protected under the EPBC Act recorded within the project area included the Rainbow Bee-eater, Eastern Great Egret, Cattle Egret, White-bellied Sea Eagle and the Black-faced Monarch.

A total of 24 mammal species (including four introduced species) were recorded during the winter survey, with an additional 19 species recorded during the spring survey. Significant species recorded included the Little Pied Bat listed as Near-Threatened under the NC Act, which was recorded at three locations and the Grey-headed Flying Fox listed as Vulnerable under the EPBC Act, which was recorded from Raglan Creek, where a mixed flying fox camp is located downstream of the proposed pipeline route.

Migratory fauna

A search of the EPBC Act Protected Matters Search Tool identified 13 migratory fauna species within 20 km of the proposed pipeline route (refer to **Appendix A4.4**, **Volume 3**). The Rainbow Bee-eater, Eastern Great Egret, Cattle Egret, White-bellied Sea Eagle and the Black-faced Monarch listed as migratory species under the EPBC Act were recorded within the project area during the field surveys.

Introduced fauna

The desktop search identified 24 introduced fauna species within the project area (refer to **Appendix A4.4, Volume 3**), seven of which were recorded during the field surveys which are provided in **Table 4-71**.

Table 4-71: Introduced fauna known from the project area

Class	Scientific name	Common name	LP Act status
Amphibians	*Rhinella marina*	Cane Toad	n/a
Birds	*Passer domesticus*	House Sparrow	n/a
Mammals	*Bos taurus*	European Cattle	n/a
Mammals	*Canis familiaris*	Dog	Class 2
Mammals	*Canis lupus dingo*	Dingo	Class 2
Mammals	*Felis catus*	Cat	Class 2
Mammals	*Sus scrofa*	Pig	Class 2

Corridor values

The proposed pipeline route traverses five terrestrial biodiversity corridors and 15 riparian corridors identified in the comprehensive biodiversity planning assessments (BPAs) for the Brigalow Belt Bioregion (EPA, 2008). The ROW contains 486.3 ha of mapped corridor, however, 50.8% of the area identified within BPA corridors is cleared with low ecological value in its present condition.

Linear corridors of vegetation are associated with all major waterways (greater than stream order 2) within the project area. In many instances however, these corridors are highly compromised due to chronic grazing pressure, continues thinning of vegetation and a general lack of habitat complexity. The riparian zone of the Isaac and Fitzroy Rivers, although degraded in many locations, provides an important dispersal pathway through the project area, particularly for birds and bats.

Major terrestrial corridors in the project area are associated with the Denham Range (eastwest) Kerlong Range (northsouth) and Broadsound Range (northsouth). These ranges are well vegetated due to their inaccessibility and lack of agricultural activity, and they are characterised by extensive tracts of remnant vegetation. However, they are dissected in many locations by roads and other linear infrastructure.

4.8.1.3. Aquatic ecology

Aquatic and marine flora

The Reach Environs (land use adjacent to the riparian zone) is generally good to very good (an excellent rating is applied to undisturbed natural vegetation) throughout much of the project area. The primary disturbance observed during the survey was associated with grazing impacts. River banks are mainly stable with river flows, wave action and uncontrolled stock access the major causes of instability. Stream bed and bar formations are generally stable along most river reaches with bank instability and stock access the biggest threats to stability. Channel habitat diversity is low to very low with runs and pools the most common habitat recorded across the catchment.

Riparian vegetation condition is highly variable with ratings ranging from very poor to very good. Very poor ratings were associated with narrow riparian corridors and introduced vegetation. Typically the riparian community is dominated by *Melaleuca spp., Eucalyptus spp., Acacia asp. Lysiphyllum spp and Callistemon spp*. However, a number of weed species are also common throughout the riparian zone including *Lantana spp, Parthenium hysterophorus (Parthenium weed) and Parkinsonia aculeate (Parkinsonia)*. Generally, the region lacks aquatic vegetation.

The majority of the waterways and wetlands intersected by the proposed pipeline route are likely to be ephemeral and contain limited habitat for aquatic species. Nevertheless, 35 aquatic and semi-aquatic flora species were recorded in wetlands within the project area by the Queensland Herbarium (refer to **Appendix A4.3**, **Volume 3**). In addition, 29 aquatic flora species were recorded within the ROW during the terrestrial flora (refer to **Appendix A4.3**, **Volume 3**) and aquatic ecology (refer to **Appendix A4.13**, **Volume 3**) surveys and are identified in **Table 4-72**.

Table 4-72: Native aquatic flora species recorded in the ROW during field surveys

Scientific name	Common name	Habitat	Source*
Azolla pinnata	Azolla	Freshwater	AECOM/SKM
Baumea articulata	Jointed Twig-Rush	Freshwater	SKM
Bolboschoenus calwellii	Club-rush	Freshwater	SKM
Ceratophyllum demersum	Hornwort	Freshwater	SKM
Cyperus species	Unknown Sedge	Freshwater, semi-aquatic	AECOM
Elecharis spp	Unknown Rush	Freshwater	SKM
Eleocharis dulchus	Chinese Water Chestnut	Freshwater	AECOM
Eleocharis sphacelata	Tall Spike-Rush	Freshwater	SKM
Elodea canadensis	Elodea	Freshwater	SKM
Fimbristylis species	Unknown Sedge	Freshwater, semi-aquatic	AECOM
Hydrilla verticillata	Hydrilla	Freshwater	SKM
Juncus species	Common Rush	Freshwater, semi-aquatic	AECOM/ SKM
Ludwigia octovalvis	Primrose	Semi-aquatic	AECOM
Ludwigia peploides	Water Primrose	Freshwater	SKM
*Marsilea mutica**	Nardoo	Freshwater	AECOM/ SKM
Myriophyllum	Water Milfoil	Freshwater	SKM
Nitella sp. / Chara spp.	Stonewart	Freshwater	SKM
Nymphaea violacea	Native Waterlilly	Freshwater	AECOM/ SKM
Nymphoides indica	Water Snowflake	Freshwater	SKM
Ottelia ovalifolia	Swamp Lilly	Freshwater	AECOM/ SKM
*Persicaria decipens**	Slender Knotweed	Semi-aquatic	AECOM/ SKM
*Phragmites australis**	Common Reed	Freshwater	AECOM/ SKM
Potamogeton crispus	Curly Pondweed	Freshwater	AECOM/ SKM
Potamogeton pectinatus	Sago Pond weed	Freshwater	SKM
Potamogeton tricarinatus	Floating Pondweed	Freshwater	SKM
Pseudoraphis spinescens	Spiny Mudgrass	Freshwater	AECOM
Triglochin procerum	Water Ribbons	Freshwater	SKM
Typha spp.	Cumbungi	Freshwater	SKM
Utricularia sp.	Yellow Bladderwort	Freshwater	AECOM

* AECOM – Terrestrial Flora Assessment (refer to Appendix A4.3, Volume 3), SKM – Aquatic Ecology Assessment (refer to Appendix A4.13, Volume 3)

The proposed pipeline route traverses saltmarsh and mangrove communities along a 350 m section in the south of the project area (AB446.4 to 446.8) and a 40 m section near AB430. These marine plants include Saltwater couch (*Sporobolus virginicus*), Ruby saltbush (*Enchylaena tomentosa*), Grey mangrove (*Avicennia marina*), River mangrove (*Aegiceras corniculatum*), Yellow mangrove (*Ceriops tagal*), Milky mangrove (*Excoecaria agallocha*), Beaded Glasswort (*Sarcocornia quinqueflora*), Austral seablite (*Suaeda australis*) and Sea lavender (*Limonium solanderi*).

Aquatic fauna

A search of the DERM Wildlife Online Atlas indicated that 39 native aquatic fauna species and two introduced aquatic fauna species are known to occur within the project area (refer **Appendix A4.13**, **Volume 3**).

The Fitzroy River Turtle (*Rheodytes leukops*), listed as Vulnerable under the NC and EPBC Act is identified as potentially occurring within 10 km of the proposed pipeline route. It is also recognised as Vulnerable under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Australasian Reptile & Amphibian Specialist Group, 1996).

The Estuarine Crocodile (*Crocodylus porosus*) (also known as saltwater crocodiles), listed as Vulnerable under the NC Act, may exist or have suitable habitat within the project area. Typically the Estuarine Crocodile lives in the tidal reaches of rivers, however it can also occur in freshwater lagoons and swamps, sometimes hundreds of kilometres inland from the coast. The Fitzroy River at Glenroy is the most southern known nesting point for Estuarine Crocodiles (Inglis & Howell 2009). Recent surveys have identified crocodiles at four locations in the lower Fitzroy River (Sullivan *et al.* 2010); however nesting crocodiles have also been recorded at Conroy Crossing (Iglis & Howell, 2009).

The platypus (*Ornithorhynchus anatinus*) is listed as Least Concern under the NC Act. Platypus are known to occur in freshwater creeks, slow moving rivers, lakes and even in farm dams (EPA, 2004). Platypus spend part of their time out of the water, resting in burrows in the banks of watercourses (Serena et al, 1998). Previous studies have suggested that the placement of platypus burrows may be influenced by certain bank characteristics such as the presence of trees, bank undercutting, slope and the degree of soil impact (Serena et al., 1998).

During aquatic field surveys, aquatic habitat ratings were highly variable, ranging from very poor to very good. Twigs, leaf packs and large logs were the dominant habitat identified; however, overhangs and trailing back vegetation were also recorded. Aquatic fauna passage was generally restricted due to the absence of flows for many reaches; however, fords, log jams, weirs and rapids were also identified as potential waterway barriers.

During the field surveys, 15 native species of fish and aquatic reptiles (refer to **Table 4-73**) were captured. Eastern Rainbowfish (*Melanotaenia splendida*) was the most abundant fish recorded with over 256 individuals present at 11 sites. None of the fish species recorded during field surveys have a state or Commonwealth conservation status. Platypus were not captured during the aquatic ecology surveys, however, they were observed during the terrestrial fauna field survey (**Appendix A4.4**, **Volume 3**).

Table 4-73: Aquatic fauna species recorded during field surveys

Scientific name	Common name
Ambassis agassizii	Agassiz's Glassfish
Anguilla reinhardtii	Longfin Eel
Craterocephalus stercusmuscarum	Flyspecked Hardyhead
Glossamia aprion	Mouth Almighty
Hypseleotris compressa	Empire Gudgeon
Hypseleotris klunzingeri	Western Carp Gudgeon
Leiopotherapon unicolor	Spangled Perch
Melanotaenia splendida splendida	Eastern Rainbowfish
Mogurnda adspersa	Purplespotted Gudgeon
Mugilidae spp	Freshwater Mullet
Nematalosa erebi	Bony Bream
Neoarius graeffei	Blue Catfish
Neosilurus hyrtlii	Hyrtl's Catfish
Chelodina expansa	Broad-shelled River Turtle
Emydura macquarii krefftii	Krefft's River Turtle

Aquatic weeds and introduced fish species

Data from Biosecurity Queensland's Annual Pest Distribution Survey data indicates that there are a number of aquatic and semi-aquatic weeds whose distribution may extend to the project area. The species identified are listed in **Table 4-74** with their state classification under the LP Act, and whether the species is a WONS. While the predictive mapping indicates highly suitable habitat for a number of species, none were not identified during the survey.

Table 4-74: Desktop assessment of aquatic weeds with potential distribution in the project area

Species	Common name	WONS	State classification under the LP Act		
			Class	Presence/ absence	Predictive mapping
Alternanthera philoxeroides	Alligator weed	Yes	Class 1	Absent	Suitable
Hymenachne amplexicaulis	Hymenachne or olive hymenachne	Yes	Class 2	Absent	Suitable
Gymnocoronis spilanthoides	Senegal tea plant	No	Class 1	Absent	Moderate suitability
Salvinia molesta	Salvinia	Yes	Class 1	Absent	Suitable
Cabomba spp.	Cabomba	Yes	Class 1 & 2	Absent	Highly suitable
Stratiotes aloides	Water soldiers	No	Class 1	Absent	Very low suitability
Lagarosiphon major	Lagarosiphon	No	Class 1	Absent	Low – moderate suitability
Pistia stratiotes	Water lettuce	No	Class 2	Absent	Highly suitable
Eichhornia crassipes	Water hyacinth	No	Class 2	Absent	Highly suitable
Mimosa pigra	Mimosa pigra	Yes	Class 1	Absent	Marginally suitable
Neptunia oleracea	Water mimosa	No	Class 1	Absent	Not available
Ludwigia peruviana	Peruvian primrose bush	No	Class 1	Absent	Highly suitable
Myriophyllum spicatum	Eurasian water milfoil	No	Class 1	Absent	Highly suitable
Trapa natans	Floating water chestnut	No	Class 1	Absent	Very low suitability
Equisetum arvense	Horsetails	No	Class 1	Absent	Very low suitability
Equisetum hyemale	Horsetails	No	Class 1	Absent	Low suitability

A search of DERM‘s Wildlife Online Atlas indicated that two introduced aquatic fish species, Gambusia (*Gambusia Holbrooki*) and the Guppy (*Poecilia reticulata*) are known to occur within the project area. Only Gambusia was observed during the field survey.

4.8.2. POTENTIAL IMPACTS AND MITIGATION

Potential impacts have been determined from the results of field surveys which have been used to ground-truth desktop assessments.

4.8.2.1. Terrestrial flora impacts and mitigation

Protected Area Estates

No areas of protected area estate lie adjacent to, or are traversed by the ROW. As such, there is unlikely to be any impacts from the project‘s construction or operational activities.

Vegetation communities

The proposed pipeline route traverses approximately 124 km (or 21.35% of the proposed pipeline route) of remnant vegetation. The total disturbance area would be approximately 371.2 ha of remnant vegetation (456.29 ha including high value regrowth) based on the entire 30 m of the ROW being cleared.

The key flora values potentially affected by clearing for the project include:

- Loss of Endangered brigalow communities on alluvial plains (RE 11.3.1);
- Loss of Endangered brigalow communities on clay plains (RE 11.4.9);
- Loss of Endangered Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (RE 11.8.11);
- Loss of 12 Of Concern REs (RE 11.3.2, 11.3.3, 11.3.4, 11.3.7, 11.3.25, 11.3.27, 11.3.36, 11.4.2 11.7.1x1, 11.8.11, 11.9.7, 11.11.16);
- Loss of 16 No Concern at Present REs (RE 11.1.1, 11.1.4, 11.3.26, 11.5.3, 11.5.8, 11.5.9, 11.5.12, 11.7.2, 11.8.5, 11.9.2, 11.9.9, 11.11.1, 11.11.4. 11.11.15, 11.12.1, 11.12.2);
- Impacts on four EVNT flora species recorded in or close to the proposed pipeline route during the field surveys;
- Loss of potential habitat for EVNT flora species (detected and mapped);
- Loss of freshwater wetland ecosystems and associated riparian vegetation;
- Loss of marine wetlands and associated marine plants; and
- Fragmentation of remnant vegetation blocks.

The estimated maximum clearing requirements (i.e. the 30 m ROW cleared) for each biodiversity conservation category of remnant vegetation and regrowth are identified in **Table 4-75** (and detailed in **Appendix A4.3**, **Volume 3**).

Table 4-75: Clearing of remnant vegetation

Biodiversity Status	Area in ROW (ha)	Area in project area (5 km buffer) (ha)	% in project area
Endangered	1.34	12,339.37	0.01
Of Concern	83.55	55208.42	0.15
No Concern at Present	287.20	123,390.7	0.23
Regrowth	372.1	123390.7	0.38

During ongoing inspections and maintenance of the proposed pipeline, a reduced area will be required along the proposed pipeline route. A 7 m area may be sufficient to protect the pipeline from root damage allowing the remaining 23 m to regenerate naturally in the medium term (20 to 50 years).

Two EPBC-listed communities were recorded within the ROW which transects five areas of these EECs:

- Brigalow (11.3.1) - from AB167.69 to AB167.98;
- Brigalow (11.4.9) - from AB44.42 to AB44.51 and AB93.35 to AB93.48; and
- Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (11.8.11) - from AB35.01 to AB36.45 and AB36.79 to AB37.0.

A maximum of 6.33 ha would be impacted if the entire 30 m ROW required clearing, representing 0.13% of these EECs occurring within the project area (5 km buffer).

Regional Ecosystems

Two REs with an Endangered biodiversity status were recorded within the ROW. The proposed pipeline route transects three areas of these Endangered REs, including:

- One area with a mix of *Eucalyptus* spp. and / or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains (11.4.2 - Of Concern) and *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains (11.4.9 - Endangered);
- One area of *Acacia harpophylla* and / or *Casuarina cristata* open forest on alluvial plains (11.3.1 - Endangered); and
- One area of *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains (11.4.9).

A maximum of 1.34 ha (or 0.04% of the project area) would be impacted based on clearing of the 30 m ROW.

A total of 12 REs with an Of Concern biodiversity status were recorded within the ROW. The proposed pipeline route transects 120 areas of Of Concern REs, including:

- Fifty-two areas of *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (11.3.25);
- Twenty-two areas of *Eucalyptus populnea* woodland on alluvial plains (11.3.2);
- Fourteen areas of *Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks (11.9.7);
- Six areas of *Eucalyptus coolabah* woodland on alluvial plains (11.3.3);
- Six areas of *Eucalyptus tereticornis* and / or *Eucalyptus* spp. tall woodland on alluvial plains (11.3.4);
- Eight areas of *Corymbia* spp. woodland on alluvial plains (11.3.7);
- Three areas of Freshwater wetlands (11.3.27);
- Two areas of *Eucalyptus crebra* and / or *E. populnea* and / or *E. melanophloia* on alluvial plains. Higher terraces (11.3.36);
- Two areas of Semi-evergreen vine thicket (11.7.1x1);
- Two areas of *Dichanthium sericeum* grassland on Cainozoic igneous rocks (11.8.11);
- Two areas of *Eucalyptus cambageana*, *Acacia harpophylla* woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands (11.11.16); and
- One area of *Eucalyptus spp*. and / or *Corymbia spp*. grassy or shrubby woodland on Cainozoic clay plains (11.4.2).

A maximum of 83.5 ha (or 0.15% of the project area) would be impacted based on clearing of the 30 m ROW.

A total of 16 REs with a No Concern at Present biodiversity status were recorded within the ROW. The proposed pipeline route transects 144 areas of No Concern at Present REs, including:

- Forty-nine areas of *Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* on Cainozoic sand plains / remnant surfaces (11.5.3);
- Twenty areas of *Eucalyptus crebra* woodland on fine-grained sedimentary rocks (11.9.9);

- Eighteen areas of *Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains / remnant surfaces (11.5.9);
- Ten areas of M*elaleuca* spp., *Eucalyptus crebra*, *Corymbia intermedia* woodland on Cainozoic sand plains / remnant surfaces (11.5.8);
- Eight areas of *Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics (11.11.15);
- Six areas of *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks (11.8.5);
- Thirteen areas of *Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone (11.7.2);
- Four areas of *Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains (11.3.26);
- Three areas of Mangrove forest/woodland on marine clay plains (11.1.4);
- Three areas of *Corymbia clarksoniana* woodland and other *Corymbia* spp. and *Eucalyptus* spp. on Cainozoic sand plains / remnant surfaces.(11.5.12);
- Two areas of *Sporobolus virginicus* grassland on marine clay plains (11.1.1);
- Two areas of *Eucalyptus crebra* woodland on igneous rocks (11.12.1);
- Two areas of *Eucalyptus crebra* woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges (11.11.4);
- Two areas of *Eucalyptus melanophloia* woodland on igneous rocks (11.12.2);
- One area of *Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks (11.9.2); and
- One area of *Eucalyptus crebra* +/- *Acacia rhodoxylon* woodland on old sedimentary rocks with varying degrees of metamorphism and folding (11.11.1).

A maximum of 287.21 ha (or 0.22% of the project area) would be impacted based on clearing of the 30 m ROW.

The proposed ROW contains 84.2 ha of HVR vegetation, which represents approximately 0.68% of the area of HVR within the project area. This includes 19.59 ha of HVR of Endangered RE, 24.83 ha of HVR of Of Concern RE and 39.78 ha of HVR of Least Concern RE. Estimated clearing figures of REs with an Endangered, Of Concern and No Concern at Present Biodiversity Status are provided in **Appendix A4.3**, **Volume 3**.

The indirect impacts of construction and operation on REs may include erosion, sediment loss and weed invasion. These impacts are unlikely to be significant provided adequate erosion and sediment control and weed management measures are implemented. Subject to the successful implementation of the mitigation recommendations provided in the EIS, the potential impacts on the REs are expected to be limited to the direct impact associated with the proposed disturbance footprint.

Proposed mitigation measures for vegetation to avoid or minimise clearing of areas of high environmental value and areas of remnant vegetation include minor realignments of the proposed pipeline route.

The locations and recommendations for minor realignments of the proposed pipeline route are provided in **Appendix A4.3**, **Volume 3**. These will be considered during detailed design to minimise potential impacts to Endangered and Of Concern communities.

The area affected would be reduced by utilising pre-existing clearings and reducing clearing widths in endangered communities. Additional mitigations are recommended to help avoid and minimise potential impacts on flora, including:

- The corridor impacted upon by the pipeline construction will be minimised within all areas of remnant vegetation. Clearing widths will be restricted to 30 m;
- Clearing of remnant vegetation areas will be avoided for the purposes of situating construction camps, lay down areas, vehicle access tracks and other ancillary impact areas, wherever possible; and
- Clearing boundaries within remnant vegetation areas will be clearly marked in the field.

Endangered, Vulnerable and Near Threatened flora species

The desktop assessment identified 34 EVNT flora species recorded or potentially occurring within the study area. As identified in **Section 4.8.1.1**, four EVNT plant species (*Cerbera dumicola, Desmodium macrocarpum, Eucalyptus raveretiana* and *Euphorbia sarcostemmoides*) were recorded in the project area.

Potential impacts from the pipeline construction on the EVNT species are likely to be limited to the direct loss of plants within the ROW and associated disturbance areas (e.g. access tracks) and the introduction of weeds. It is possible to identify a route within the identified sections that will avoid direct impacts on these populations.

Pre-construction surveys will be conducted for EVNT flora species. Surveys will include the 30 m ROW of the final alignment and immediately adjacent areas that may be disturbed by construction activities. Any individuals and populations detected during surveys should be marked before construction commences and actions taken to reduce impacts where possible (e.g. minor route realignments, flagging and / or barrier fencing of populations adjacent to the ROW as no-go areas).

Wetlands

A total of four REs identified as wetland REs were recorded within the proposed ROW. The alignment transects 60 areas of REs containing wetlands, including:

- Fifty two areas of *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (11.3.25);
- Three areas of Freshwater wetlands (11.3.27);
- Three areas of Mangrove forest/woodland on marine clay plains (11.1.4); and
- Two areas of *Sporobolus virginicus* grassland on marine clay plains (11.1.1).

A maximum of 23.3 ha (or 0.64% of the project area) would be impacted based on 30 m ROW clearing.

Aquatic ecosystems may be indirectly affected by altered water, sediment and nutrient flows if watercourse disturbance is not effectively managed. Construction works may also lead to the introduction and spread of aquatic weeds, such as hymenachne (*Hymenachne amplexicaulis*). Several route realignments will be investigated to avoid these wetland areas as described in **Appendix A4.3, Volume 3**.

Riverine wetlands were recorded on 52 watercourses transected by the proposed pipeline route. In some large watercourses (e.g. Fitzroy River, Isaac River and Raglan Creek), the use of HDD techniques will be investigated, subject to geotechnical conditions, to avoid impacts.

Construction will be scheduled in the dry season wherever possible (especially in, and adjacent to, watercourses and wetlands). Additionally, minimising clearing widths in beds of watercourses and minimising impacts on water, sediment and nutrient flows will minimise impacts to wetlands.

Terrestrial weeds

The construction and maintenance of the proposed pipeline has the potential to introduce new weeds and spread existing weeds. Introduction and spread of declared weeds can render land less productive and in some cases have serious health impacts on livestock (and on people in the case of *parthenium*).

Monitoring of weed infestations within disturbed areas will occur biannually during construction and then biannually for a period of two years following construction. Monitoring in areas of known *parthenium*, giant rat's tail grass and African lovegrass infestations will be undertaken quarterly or in accordance with respective landholder concerns. Appropriate weed control measures will be applied. Following the two year period, the frequency of monitoring will be reconsidered dependent on the success of control measures and the level of infestations.

A Weed Management Plan that addresses the construction, rehabilitation and operation phases of the project will be prepared prior to construction and will include hygiene protocols to minimise the likelihood of introduction and spread of environmental, agricultural and declared weeds.

Terrestrial flora offsets

While all practicable efforts will be made to avoid and minimise impacts on flora of high ecological value, it is likely that small areas will be cleared or disturbed for construction and operation of the pipeline. Where residual impacts cannot be avoided, an offset plan will be prepared and implemented to rehabilitate vegetation similar to that of the impacted vegetation in a nearby location.

The goal of any offset program will be to achieve a net conservation gain by enhancing the long term sustainability of the vegetation in the Bioregion. Offsets will be developed in liaison with relevant Commonwealth and state regulatory agencies.

Based on the proposed pipeline route, clearing of the ROW may result in the removal of the following maximum areas of ecological values that require offsets:

- 5.83 ha of Endangered Ecological Communities under the EPBC Act;
- 0.85 ha of REs with Endangered biodiversity status identified by DERM;
- 77.63 ha of REs with Of Concern biodiversity status identified by DERM;
- 0.4 ha of Essential Habitat identified by DERM;
- 19.96 ha of wetlands identified by DERM;
- 18.3 ha of habitat for EVNT flora species under the NC Act or EPBC Act; and
- 0.1 ha of marine vegetation under the Fisheries Act.

These figures are likely to be reduced by further refinements of the proposed pipeline route.

Provided that the recommended mitigation measures outlined in **Section 4.8.3** and **Appendix A4.3, Volume 3** are implemented effectively, residual impacts are anticipated to be limited to:

- Clearing of less than 372.1 ha of remnant vegetation;
- Impacts on several EECs and Endangered and Of Concern REs which would be addressed through an offset plan to achieve a net conservation gain (via rehabilitation to remnant status and protection of larger areas of equivalent REs);
- Little or no impacts on EVNT flora species and essential habitat; and
- Minor impacts on riparian wetlands and marine wetlands.

Two areas subject to proposed vegetation offsets are currently being examined. One area for Bluegrass (AB35.0 to AB36.4 and AB36.9 to AB37.15) and the other for Brigalow (AB163.7 to AB163.9). The second area subject to Brigalow is currently being investigated for a potential route change further to the east, closer to the Fitzroy Development Road which will avoid this small belt of Brigalow.

Should vegetation offsets be required, an offset plan will be developed in conjunction with DERM.

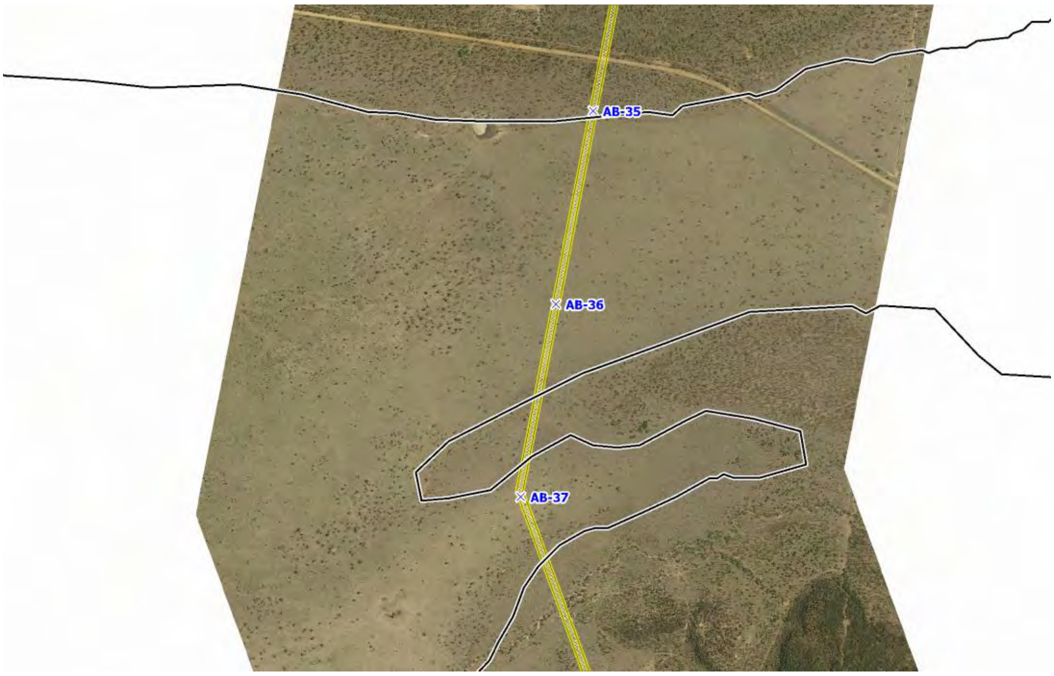


Figure 4-17: Area of Bluegrass transacted by the proposed pipeline route

Figure 4-18: Small area of brigalow currently transacted by the proposed pipeline.

4.8.2.2. Terrestrial fauna impacts and mitigation

Fauna habitat

The proposed pipeline route traverses approximately 124 km of remnant vegetation (or 21.35%). Assuming that the 30 m ROW contains remnant vegetation, the total disturbance area will be approximately 371.2 ha of remnant vegetation (with a maximum disturbance of 456.29 ha if high value regrowth is added). The RE type to be cleared and specific impacts to fauna habitat values for each RE is detailed in **Appendix 4.4**, **Volume 3**. The removal of vegetation will result in disturbance to habitats that support fauna species including EVNT species. Other potential impacts include removal of some hollow-bearing mature trees and therefore loss of perching, foraging and nesting resources for fauna especially nesting birds, microbats and marsupial gliders, and removal of tree species with abundant decorticating bark which is preferred foraging substrate for a variety of woodlands birds and reptiles.

Areas of essential habitat have been avoided as far as possible along the proposed pipeline route. In the few areas where the pipeline does traverse essential habitats, the crossing has been located along existing cleared easements or in other disturbed habitats, as far as practical. The location of the proposed route in these disturbed areas is intended to reduce and avoid impact on areas of essential habitat.

The clearing of mature and hollow-bearing trees along the alignment will be minimised, by ensuring that only the 30 m ROW is cleared and by retaining mature and hollow-bearing trees that occur on the edge of the ROW where practical, through minor realignments of the ROW. A pre-construction survey will be undertaken by an appropriately qualified ecologist to clearly identify and mark hollow-bearing trees or other ecologically sensitive areas. A suitably qualified and experienced fauna spotter / handler will be present during vegetation clearing to minimise the potential harm to fauna species and recover any injured fauna. During construction, trimming of branches will be considered along the edge of the ROW in preference to the removal of entire trees, where possible. Trees will not be allowed to grow within 3.5 m of the pipeline centreline during operation.

Endangered, Vulnerable and Near Threatened fauna species

A review of relevant desktop data and completion of field surveys indicates that 24 EVNT species are considered to have a moderate to high likelihood of occurrence, or have already been recorded, within the proposed pipeline route. Of these, nine species have been identified as being potentially adversely affected by the project (refer to **Appendix A4.4**, **Volume 3**):

- Powerful Owl (*Ninox strenua*) – Loss of large habitat trees which are used for nesting and refugia for prey species such as the Greater Glider;
- Yellow Chat (*Epthianura crocea macgregori*) – Potential disturbance to wetland areas which may provide habitat for the species;
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Loss of foraging and disturbance to known roost sites;
- Little Pied Bat (*Chalinolobus picatus*) – Loss of potential den / roost sites in hollow-bearing trees; and
- Common Death Adder (*Acanthophis* antarcticus), Ornamental Snake (*Denisonia maculate*), Grey Snake (*Hemiaspis damellii*), Brigalow Scaly-foot (*Paradelma orientalis*) and Yakka Skink (*Egernia rugosa)* – Loss of preferred habitat and potential trenchfall.

Proposed mitigation measures to minimise impacts on EVNT fauna species include minimising the disturbance footprint, modifying the ROW to protect large trees and significant habitat features, as required. For the Yellow Chat, impacts to wetland areas will be minimised through avoidance, HDD, dry season construction scheduling, and post-construction habitat rehabilitation if required.

Potential trenchfall impacts may also occur as an open trench will be required for the laying of the pipeline. The open trench provides a temporary barrier to fauna movement and the potential for ground-dwelling fauna (such as reptiles, frogs and small mammals) to fall into the trench and become trapped and exposed to overheating, dehydration and / or predation. The trench will vary between 1.2 and 2 m in depth and may be of a sufficient depth to result in fauna mortalities from falling into the trench. Fauna entrapment within the pipeline trench has been recognised as a key environmental issue by the Australian Pipeline Industry Association Code of Environmental Practice.

The trenching will be progressive, and therefore the full length of the pipeline will not be open at any given time. The length of open trench will vary according to the underlying geology and terrain, but will be minimised where practical. A qualified and experienced fauna spotter / handler should check the trench for captured fauna at least daily, preferably in the morning to remove animals prior to the heat of the day.

Connectivity and fragmentation

The construction of the pipeline has the potential to create a short term barrier to fauna movement by restricting access for some species across the cleared land within the ROW.

The clearance of vegetation in intact habitat patches changes the structure and dynamics of the patches and local fauna populations and the cleared ROW creates additional edges to habitat patches and the suite of changes which occur in the vicinity of the edge are termed ‗edge effects'. Edge effects are greatest within patches containing structurally complex vegetation such as vine thickets, Brigalow communities and riparian zones. Edge effects may produce changes to plant species composition (including resources for fauna), prevent the movement of some species across the cleared ROW and provide access for pest species that would otherwise not occur within the habitat type. The majority of the proposed pipeline route is in pasture / grassland, which is the habitat least affected by connectivity or fragmentation impacts.

Operational impacts on terrestrial fauna are considered to be minimal due to the rehabilitation and revegetation of the majority of the pipeline ROW, where appropriate. Within structurally complex vegetation such as riparian areas, the cleared pipeline easement may present a barrier to some fauna species, although the majority of species present are adapted to dispersal across open woodland habitats and are therefore likely to be tolerant of small canopy gaps. The easement is a permeable barrier, unlike a physical structure or large water body. Although the easement will be kept free of deep-rooted trees for pipeline maintenance, ground covers will provide shelter for small fauna species crossing the area.

Minor realignments of the proposed pipeline route during detailed design will aim to minimise edge effects by avoiding passing directly through intact habitat patches but only touch one edge of the patch. In addition, progressive rehabilitation will ensure that the pipeline easement remains permeable for dispersing fauna thereby maintaining movement corridors.

Migratory species

A review of relevant desktop data and completion of field surveys indicates that 13 migratory species are considered to have a moderate to high likelihood of occurrence within the proposed pipeline corridor or have already been recorded. No migratory fauna species have been identified as being adversely affected by the project, therefore no mitigation measures have been proposed.

Introduced fauna

Vertebrate pests are present throughout the project area. The construction of the project is unlikely to significantly increase the distribution or abundance of vertebrate pests as these species will lose habitat. However, dingoes / wild dogs and introduced murid (rats and mice) may be attracted to work sites if food or scraps are available. Maintenance of good hygiene practices during construction, particularly with regard to waste disposal, will assist in minimising the spread and proliferation of fauna pest species.

4.8.2.3. Aquatic ecology impacts and mitigation

Aquatic and marine flora

The desktop assessment identified 35 aquatic flora species recorded within the project area. Targeted searches for these species during field assessments revealed the presence of fourteen aquatic species. No EVNT aquatic flora species were detected.

The proposed alignment transects 0.35 km of saltmarsh (RE 11.1.1) and mangrove (RE 11.1.4) communities, which contain marine plants and bare marine substrate, at AB446.4 to 446.8 and AB430. Assuming that the entire 30 m ROW contains marine vegetation and / or habitat and requires removal for construction, the maximum total disturbance area would be approximately 1.05 ha.

The proposed pipeline route will potentially impact riparian plant species and aquatic plant species associated with watercourses and natural waterholes / wetland areas. Potential impacts from conventional construction are likely to include direct loss of marine plants, loss of marine habitat, changes in hydrology, transport of sediment and other pollutants and aquatic weed invasion. Most species are widespread and abundant, so are unlikely to be significantly impacted by construction of the pipeline. Mitigation measures include pipeline route realignments during detailed design to avoid aquatic, riparian and marine vegetation, where possible and use of HDD under marine and aquatic vegetation at Fitzroy River, Isaac River and Raglan Creek.

Aquatic fauna

Construction of watercourse crossings will involve open cut trenching or HDD.

Standard open cut trenching construction will be used in dry or low flow conditions. Where trenching occurs, burrowing fauna such as platypus may be affected, turtle nests may be unearthed and fish passage may be disrupted. During low flows (typically less than 1,000 L/s) water will either be concentrated through a flume pipe or pumped around the work area via standard flow diversion techniques or through the construction of barrier dykes / head walls above and below the trenched area.

Trenching will occur over several days at each watercourse and any potential disturbances to aquatic fauna will be temporary in nature. Disruption to fish passage will be minimised at trenching locations through the provision of adequate stream/flow diversions and minimising the duration of trenching activities. Flows will be reinstated as soon as trenching is completed at each location. Mobilisation of sediments, nutrient enrichment and accidental release of other pollutants may also occur during trenching which would affect water quality and thus aquatic fauna. As construction of watercourse crossings is planned for periods of low flow, the potential impacts to water quality are expected to be minimal and temporary in nature.

For significant watercourse crossings (e.g. Fitzroy River, Isaac River and Raglan Creek), HDD will be used (subject to geotechnical verification). HDD involves the positioning of a drilling machine away from the bank and driving the pipe under the watercourse without creating physical disturbance of the bed and banks of the watercourse. HDD is proposed for the Isaac and Fitzroy River crossings and no impacts to the Fitzroy River Turtle, platypus or fish passage are expected at these sites from drilling activities.

In most instances, an access track over the watercourse will be required to provide access along the ROW. Access across watercourse crossings includes fords, causeways, flume crossings or temporary bridging. It has been assumed that any access tracks will remain in place until the pipeline has been tested and rehabilitation is completed.

Access track watercourse crossings (including bed level watercourse crossings), are considered to be watercourse barriers under the SP Act and the Fisheries Act. Access tracks have the potential to injure or disrupt normal behaviour of some aquatic fauna (such as platypus and turtles), and also disrupt natural hydrology and slow or prevent fish movement which affects the health, distribution and populations of native fish. Construction of access tracks where flowing water is present may result in temporary minor impacts to water quality from mobilisation of sediments. The impacts will be minimised by installing flume pipes and careful location of the crossings away from sensitive areas. Flows will be reinstated as soon as access tracks are removed.

Aquatic weeds and introduced fish species

There is a risk that construction activities could potentially promote the spread of weed species found in riparian areas along the proposed pipeline route. The aquatic weed, Elodea/Egeria, may be present within watercourses in the region, especially following a significant rainfall event. The risk of spreading aquatic weed Elodea/Egeria from construction activities is low, as the weed does not persist in intermittently flowing streams and permanent pools which provide ideal conditions for Egeria/Elodea will be underbored via HDD. A Weed Management Plan will be developed and implemented to prevent weed incursion in to riparian areas at watercourse crossings, and the potential spread of aquatic weeds.

Construction activities are not likely to result in the spread of the noxious fish, Gambusia (*Gambusia Holbrooki*), however, potential impacts to water quality from construction activities may create a more favourable environment for existing Gambusia populations.

4.8.3. SUMMARY

The key flora and fauna impacts associated with the construction and operation of the project include loss of remnant vegetation including Endangered, Of Concern and No Concern at Present REs and loss of flora species, loss and disturbance of potential flora and fauna habitat (including corridors), loss of riparian vegetation, loss of wetlands and fragmentation.

Appropriate mitigation measures will be implemented, including the minor realignment of the proposed pipeline route during detailed design, to avoid or minimise clearing of areas of high environmental value. An offset strategy will be developed to compensate for any residual impacts on important ecological values (e.g. EECs, Endangered and Of Concern REs, habitat for EVNT species, wetlands) (refer to **Appendix A4.3**, **Volume 3**).

The project commitments that will be undertaken to mitigate potential impacts to flora and fauna have been summarised in **Table 4-76** (refer to **Appendix A4.3**, **A4.4** and **A4.4**, **Volume 3**).

Table 4-76: Project commitments for flora and fauna impacts mitigation

Issue	Commitments
Terrestrial flora	▪ Pre-construction surveys will be conducted in the ROW and immediate adjacent areas to mark EVNT and regionally significant flora species; ▪ Topsoil (containing the natural seed bank) will be removed, stockpiled and then re-spread across rehabilitation areas as soon as possible following disturbance; ▪ Vegetation re-establishment should be monitored during and after construction; ▪ Clearing in watercourses, areas of Endangered and Of Concern vegetation and other sensitive areas should be carefully managed to minimise clearing of mature trees wherever possible; and ▪ If EVNT plants cannot be avoided, an appropriate management plan to offset biodiversity losses will be developed and implemented in liaison with relevant State and Commonwealth regulatory agencies.
Terrestrial fauna	▪ A pre-construction survey will be undertaken by an appropriately qualified ecologist to clearly identify and mark hollow-bearing trees or other ecologically sensitive areas; ▪ All fauna captured during the pre-clearing survey and spotter/catcher activities should be re-located; ▪ A suitably qualified and experienced fauna spotter/ handler will be present during vegetation clearing to minimise the potential harm to fauna species and recover any injured fauna; ▪ Ramps (with slopes of no greater than 50%) will be installed in the trench to allow the easy egress of fauna from the trench at a minimum of 1,000 m intervals. In areas of high fauna density, additional ramps and branches shall be installed to enable small fauna to exit the trench, while hessian sacks should be placed at approximately 250 m intervals for animal shelter; and ▪ A qualified and experienced fauna spotted / handler should check the trench

Issue	Commitments
	for captured fauna at least daily, preferably in the morning to remove animals prior to the heat of the day.
Aquatic ecology	▪ A pre-construction survey should be conducted to identify potential turtle nests and platypus borrows in the sandy areas of the lower Fitzroy catchment and the Isaac River; ▪ In watercourses that are potential Fitzroy River Turtle habitat, disturbance to the sandy substrate areas of these watercourse basins and banks will not occur during the breeding season (September and October), where possible; ▪ Flows will be reinstated at each site as soon as trenching is completed; and ▪ Where practical, aquatic habitat such as woody snags (if removed) should be reinstated in the watercourse post construction as appropriate.
Weeds and introduced species	▪ A Weed Management Plan will be prepared prior to construction which will include hygiene protocols to minimise the likelihood of introduction and spread of environmental, agricultural and declared weeds.

4.9. CULTURAL HERITAGE

This section presents a summary of known heritage within the project area and identifies the potential impacts on cultural heritage attributable to the project. In accordance with the TOR, an assessment of both Indigenous and non-Indigenous historical cultural heritage has been undertaken.

A *Cultural Heritage Impact Assessment Study*, undertaken by Central Queensland Cultural Heritage Management (CQCHM) is included in **Appendix A4.15**, **Volume 3**.

Legislation, policies and guidelines

A range of Commonwealth and state legislation exists to provide protection for Indigenous and non-Indigenous (historical) cultural heritage as summarised in **Table 4-77**.

Table 4-77: Legislative context

Legislation	Relevance
Commonwealth	
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)	▪ Provides for the listing of natural, historic or Indigenous places that are of outstanding national heritage value to the Australian nation as well as heritage places on Commonwealth lands and waters or under Australian Government control.
Australian Heritage Council Act 2003 (AHC Act)	▪ Established the Australian Heritage Council, mandated as the replacement body for the Australian Heritage Commission. The Council assesses nominations for the National Heritage List, and the Commonwealth Heritage List.

Legislation	Relevance
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHP Act)	▪ Provides Aboriginal and Torres Strait Island people (in any state) with the right to request the Minister for DSEWPAC to intervene in matters where the traditional cultural heritage interests of these people are considered to be at risk.
Native Title Act 1993 (NT Act)	▪ Provides for the protection of native title rights and interests (‗native title') when acts in relation to land or waters may affect native title.
State legislation	
Queensland Heritage Act 1992 (QH Act)	▪ Protects historical cultural heritage places and objects that have been entered onto the Queensland Heritage Register (QHR) from unauthorised development, although this protection can also be extended to ‗archaeological sites' that are not on the QHR.

Aboriginal Cultural Heritage Act 2003 (ACH Act)	▪ Provides effective recognition, protection and conservation of Indigenous cultural heritage.
	▪ With respect to Indigenous cultural heritage, the TOR requires that the proponent either:
	  ▪ Obtain an exemption under s86 of the Aboriginal Cultural Heritage Act 2003; or
	  ▪ Develop a Cultural Heritage Management Plan (CHMP) in accordance with the requirements of Part 7 of the ACH Act.

Curtis Coast Regional Coastal Management Plan (Curtis Coast Plan)	▪ Identifies areas of state significance (cultural heritage) on the coast that are to be protected from incompatible land uses and activities that may adversely affect the cultural heritage values of the areas. ▪ Identifies outcomes sought to be achieved in the local government area as the context for assessing development. Local governments develop planning scheme which include overlays, including a heritage places overlay.

Methodology

A desktop study was undertaken to assess the Indigenous and non-Indigenous cultural heritage within the project area including:

- A review of relevant Commonwealth and State legislation, policy and guidelines for Indigenous and non-Indigenous cultural heritage and assessing its implications for the project (as described in **Table 4-77**);
- A review of the *Cultural Heritage Impact Assessment Study* prepared by CQCHM (2011) (refer **Appendix A4.15**, **Volume 3**) which:
    - Identifies known areas of Indigenous and non-Indigenous archaeological and/or cultural importance within a 5 km buffer of the project area;
    - Assesses the results of previous cultural heritage studies conducted within a 5 km buffer of the project area;
    - Establishes a process for consulting with Aboriginal parties [7] to further identify areas of cultural significance and management measures that are appropriate in the project area;
    - Identifies, assesses and maps known areas of Aboriginal archaeological and/or cultural significance in the project area; and
    - Highlights issues to be addressed in native title agreements or a CHMP; and
    - Presents a draft HHMP.

The following literature sources were also considered:

- Cultural Heritage Coordination Unit - search of the Indigenous and Torres Strait Islander Cultural Heritage Register and Database (ICHRD);
- Cultural Heritage Branch within the Queensland Department of Environment and Resource Management (DERM) - search of places on both the QHR and Cultural Heritage Information Management System (CHIMS);
- Queensland Heritage Register – a formal search for any cultural heritage places and objects;
- DSEWPAC – search of national lists and register for information relating to any listed or identified places within the study area. This included the World Heritage

[7] ACH Act (Sections 34 and 35) creates a clear hierarchy of who constitutes the Aboriginal Party for any particular area wherein an activity is to take place.

List, the Commonwealth Heritage List, The National Heritage List and the Register of the National Estate;

- Investigations and consultation with local government authorities regarding cultural heritage areas, objects and values that have been noted within their current planning schemes;
- available web-based heritage databases for other information relating to the presence of Indigenous cultural heritage values; and
- publicly available archives, collections and publications for other Indigenous cultural heritage information of relevance.

Assessment of significance

The Burra Charter describes criteria for defining significance for Indigenous cultural heritage. The Burra Charter was developed by Australia International Council on Monuments and Sites (ICOMOS) and is endorsed by UNESCO for this purpose (ICOMOS, 1999). In the Burra Charter, cultural significance means *"aesthetic, historic, scientific or social value for past, present or future generations".*

The meaning of these terms in the context of cultural significance is discussed as follows. It should be noted that they are not mutually exclusive, for example, architectural style has both historic and aesthetic aspects.

The criteria by which the significance of cultural heritage areas, objects and values is assessed under the Burra Charter include:

- *Cultural and social significance* – all places of traditional, historical or contemporary significance, as well as clearly defined ‗archaeological sites' can be of great social significance to Aboriginal people. For Indigenous cultural heritage areas or objects as defined under the ACH Act the primary determinant of significance resides with the Aboriginal parties, consistent with their tradition;
- *Scientific significance* – the scientific significance of areas and objects represents their ability to furnish data on, and insights into, either past cultural activity (social, technological and ecological) and/or past natural/environmental conditions. In general, the scientific significance of sites increases as their potential information content increases. As a general rule, the rarer the area or object is, the greater its significance;
- *Historical significance* - an area or object has historical significance if it is associated with a significant person, event or theme. Historical significance may also include the ability of an area or object to be representative of major historical themes or cultural patterns from a particular historical period. As a general rule, it

can be taken that the more intact an area or object, including its setting, the greater its significance;

- *Educational and economic significance* – cultural heritage areas and objects may have important educational significance by providing opportunities for people to visit, examine and better appreciate the nature of these for themselves; and
- *Aesthetic significance* – the aesthetic qualities of areas includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric and the smells and sounds associated with the place and its use.

The Burra Charter definitions of significance have also been applied to the non-Indigenous historical cultural heritage assessment with the EIS.

4.9.1. DESCRIPTION OF ENVIRONMENTAL VALUES

This section presents a description of the known Indigenous and non-Indigenous cultural heritage places and objects. It provides the results of searches conducted on Commonwealth, state and local government authority heritage databases, lists, registers and planning schemes. A review of published and unpublished material relating to both the project area and its broader region is also presented. These have been used as a basis for identifying known heritage places and the form of those places.

4.9.1.1. Indigenous cultural heritage

Commonwealth register and database searches

No places within 1 km of the proposed pipeline route were identified from a review of Commonwealth heritage lists and registers.

Indigenous cultural heritage register and database

A search of the ICHRD returned 345 entries for Indigenous cultural heritage places and objects that have previously been recorded within a 5 km buffer either side of the proposed pipeline route, as shown in **Table 4-78**.

Table 4-78: Indigenous cultural heritage place types within a 5 km buffer of the proposed pipeline route

Place Type	Total	%
Cultural Place	1	0.3
Glass Artefact(s)	1	0.3
Hearth	1	0.3
Landscape Feature	2	0.6
Landscape Feature / Cultural Place	1	0.3
Quarry	4	1.2
Resource Place	1	0.3
Scarred Tree	42	12.2
Scarred Tree / Landscape Feature	1	0.3
Shell Midden	1	0.3
Stone Arrangement	1	0.3
Stone Artefact(s)	269	78.0
Stone Artefact(s) / Excavation	7	2.0
Stone Artefact(s) / Hearth	5	1.4
Stone Artefact(s) / Hearth / Campsite	1	0.3
Stone Artefact(s) / Quarry	1	0.3
Stone Artefact(s) / Scarred Tree	2	0.6
Stone Artefact(s) / Shell Midden	3	0.9
Stone Artefact(s) / Well	1	0.3
Total	**345**	

Source: Aboriginal and Torres Strait Islander Cultural Heritage Register and Database, 2011

The distribution of places is predominantly north of the Moranbah area, which accounts for the majority of the current entries on the ICHRD. This area has seen the greatest number and scale of other development projects, including open cut coal mining. Intensive cultural heritage assessments have been undertaken in association with these projects from which a range of places and objects have been identified.

A diverse range of Aboriginal place types have been identified from previous cultural heritage investigations undertaken in proximity to the project area (refer to **Table 4-78**). This includes hearths, a well, stone arrangement and shell middens, which can be considered uncommon and/or rare.

As shown in **Table 4-79**, 75 entries are located within a 1 km buffer either side of the proposed pipeline route, (this also includes 18 repeat records for the same place which are recorded on the ICHRD). Of the total 19 place types identified within the project area, 11 are present within 1 km of the proposed pipeline route.

The locations of cultural heritage places listed on the ICHRD within a 1 km buffer either side of the proposed pipeline route are shown in **Appendix A4.15**, **Volume 3**.

A total of 73 cultural heritage places are within a 1 km buffer either side of the AB mainline, as shown in **Table 4-80**.

Only one place, a scarred tree located approximately 800 m north of the current junction of the AB mainline with the EL, was noted as being associated with more than one section of the proposed pipeline route. The Elphinstone Lateral contained two additional cultural heritage places identified as a quarry and a further scarred tree.

No places are currently registered on the ICHRD near the Saraji Lateral or Dysart Lateral. These results may reflect a lack of cultural heritage investigations within these areas, or, if conducted, the lack of the results of such works being provided to DERM for inclusion on the ICHRD.

Table 4-79: Indigenous cultural heritage place types within a 1 km buffer of the proposed pipeline route

Place type	0-100	%	100-250m	%	250-500m	%	500-1000m	%	Total	%
Cultural Place	-	-	-	-	-	-	1	2.3	1	1.3
Glass Artefact(s)	-	-	-	-	-	-	1	2.3	1	1.3
Landscape Feature	-	-	-	-	-	-	2	4.5	2	2.7
Quarry	- 1	16 0.7	-	-	-	-	1	2.3	2	2.7
Resource Place	-	-	-	-	-	-	1	2.3	1	1.3
Scarred Tree	3	50	-	-	5	2 0	6	13.6	14	18.7
Scarred Tree / Landscape Feature	-	-	-	-	-	-	1	2.3	1	1.3
Stone Artefact(s)	2	33 0.3	-	-	19	7 6	27	61.4	48	64.0
Stone Artefact(s) / Excavation	-	-	-	-	1	4	1	2.3	2	2.7
Stone Artefact(s) / Hearth	-	-	-	-	-	-	2	4.5	2	2.7
Stone Artefact(s) / Well	-	-	-	-	-	-	1	2.3	1	1.3
Total	**6**	**n/a**	**0**	**n/a**	**25**	**n/a**	**44**	**n/a**	**75**	

Source: Aboriginal Cultural Heritage Register and Database, 2011

Table 4-80: Indigenous cultural heritage place types within a 1 km buffer for each section of the proposed pipeline route

Place-type	Section of the proposed pipeline route				Total
	AB Mainline	EL	SL	DL	
Cultural Place	1	-	-	-	1
Glass Artefact(s)	1	-	-	-	1
Landscape Feature	2	-	-	-	2
Quarry	1	1	-	-	2
Resource Place	1	-	-	-	1
Scarred Tree	13*	2*	-	-	14
Scarred Tree / Landscape Feature	1	-	-	-	1
Stone Artefact(s)	48	-	-	-	48
Stone Artefact(s) / Excavation	2	--	-	-	2
Stone Artefact(s) / Hearth	2	-	-	-	2
Stone Artefact(s) / Well	1	-	-	-	1
Total	**73***	**3***	**0**	**0**	**75**

Source: Aboriginal Cultural Heritage Register and Database, 2011

Note: * has a single place associated with more than one element

Of the six places identified within a 100 m of the proposed pipeline route, four are located within 50 m. These include two scarred trees, an area containing a single stone artefact and an area described as being a quarry. The status of these places will need to be confirmed as part of the cultural heritage surveys conducted with the relevant Aboriginal Parties. Further details of these places are provided in **Table 4-81-**.

Table 4-81: Indigenous cultural heritage place types within a 50 m buffer of the proposed pipeline route

State ID	Place-type	Section of proposed pipeline route	Proximity details	Date recorded	Notes
GH:G88	Stone Artefact/s	AB Mainline	8 m northeast of alignment	July 2000	Single stone artefact
GH:G96	Scarred Tree	AB Mainline and EL	40 m east of alignment	July 2000	-
GH:I91	Scarred Tree	AB Mainline	25 m west of alignment	January 2002	-
JF:A14	Quarry	AB Mainline	40 m east of alignment	January 1979	Noted as 40 m^2 in area

Source: Aboriginal Cultural Heritage Register and Database, 2011

The grid reference for the quarry place listed in **Table 4-81** is approximately 40 m to the east of the AB mainline. It is likely that the single stone artefact previously recorded as GH:G88 will lie within the proposed pipeline route. However, it is considered that the scarred trees identified as GH:G96 and GH:I91 could be avoided by the proposed pipeline route.

Local government planning schemes

Of the four Local Government Areas (LGAs) traversed by the proposed pipeline route, none of the councils (with the exception of Gladstone Regional Council) maintain separate heritage registers for either Indigenous or historical (non-Indigenous) cultural heritage.

A review of the relevant planning schemes for the Gladstone Regional Council (being the *Calliope Shire Planning Scheme* and *The Gladstone Plan*) was undertaken with respect to Indigenous cultural heritage.

The *Calliope Shire Planning Scheme* (applicable to land within the former Calliope Shire Local Government boundary) contains a list of 12 Aboriginal cultural heritage places. Although no location information is provided within the planning scheme for these places, all places have been included within the ICHRD. None of these places lie within the project area.

Other known Aboriginal cultural heritage investigations of relevance to the project

A review was also conducted of other data sources which provide additional information into the Aboriginal cultural heritage landscape.

Indigenous cultural heritage studies conducted as part of specific projects are often not publicly available as these studies are undertaken under conditions of commercial confidentiality, or where statutory provisions may also impose limits on access.

While the results cannot be directly applied to the project area, those studies undertaken in areas in close proximity to or running parallel with the proposed pipeline route, notably from Marlborough south, offer contextual information. These are described as follows, proceeding from north to south.

Central Bowen Basin

Within the central Bowen Basin, a review of the cultural heritage work for Arrow Energy's Gas Tenements (Woora Consulting Pty Ltd as per CQCHM, 2011) was conducted.

The study is dominated by places containing stone artefacts, which account for almost 80% of the total place types recorded. The vast majority of this work has been undertaken in areas immediately north of Moranbah. None of the places and objects identified are located within a 1 km buffer either side of the proposed pipeline route.

Greater Rockhampton Region

Within the Greater Rockhampton Region, numerous reviews of the Indigenous cultural heritage investigations have been previously conducted, including:

- Armagh Burials 1992;
- Marlborough Nickel Project 2006;
- AMC slurry pipeline, processing plant and gas pipeline;
- Oil shale mining in the Yaamba area (Hill, 1982);
- Summaries of a wide range of data in the lower Fitzroy catchment (Richardson, 1982);
- Stanwell Energy Park;
- Stanwell to Apis Creek Power Transmission Line;
- Rockhampton Foreshore Upgrade;
- Pandoin Powerline;
- Enertrade Moranbah to Gladstone Seam Gas Pipeline – Darumbal Section (Archaeo Cultural Heritage Services, 2006); and
- Gooreng Gooreng Cultural Heritage Project, 1993-1997.

In 2008, a study of the Pandoin Powerline was conducted between Bouldercombe and Pandoin, to the north of Rockhampton. Of the places identified, 40 were recorded alongside a 14 km section of the proposed AB Mainline. These lie within a 1 km buffer either side of the AB mainline and comprised isolated stone artefacts, spread across areas up to 30 m in diameter. The nearest places are located at least 250 m south of the AB mainline. Five unmodified stone artefacts were recorded. A series of small shovel pits were also dug to test for the possible existence of sub-surface cultural heritage material, approximately 500 m to the northeast of the AB mainline. A series of seven 50 cm by 50 cm test pits were excavated to between 160 and 300 mm below the ground surface. Two artefacts (unmodified chert flakes) were identified during this work, with both being found immediately below the present ground surface.

Cultural Heritage Investigations in Proximity to Gladstone

Within proximity to Gladstone, the following Indigenous cultural heritage investigations were reviewed:

- Alcan Smelter (Hall, 1980);
- Lend Lease Coke Plant (Hall, 1981);
- Stuart Oil Shale Project (Alfredson, G., 1989);
- Gladstone Industrial Land Project (Alfredson, G., 1992);
- Awonga Pipeline Duplication, 1997;
- Gladstone State Development Area (Aldoga) Study;
- Stuart Oil Shale Project (EIS), 1997-2006;
- Enertrade Gas Pipeline, 2006 (Archaeo Cultural Heritage Services, 2006);
- Gladstone Nickel Project, 2007 (Archaeo Cultural Heritage Services, 2007); and
- Surat to Gladstone Gas Pipeline, 2009.

Summary of Indigenous cultural heritage

The summary of database searches and other studies relevant to the project show that the project area and areas in close proximity contain stone artefacts, some scarred trees and a shell midden. These cultural heritage places and objects may be of importance to the local Aboriginal community.

A range of land practices have impacted on the project area. This is most noticeable in the eastern and southern portions of the project area. The types and intensity of these activities will have impacted on Indigenous cultural heritage.

Based on the results of a range of cultural heritage fieldwork from the broader Central Queensland region, various components of the Indigenous cultural landscape have been identified. These include places more commonly referred to as ‗archaeological sites', including stone artefacts, scarred trees, hearth / ovens, axe-grinding grooves, quarries, wells, shell scatters, burials, rock art and stone arrangements. Some of these components have been recorded either within the project area or in close proximity.

Identification of Aboriginal parties

A range of searches of the register of native title claims maintained by the National Native Title Tribunal (NNTT) have been made for the purposes of determining which groups constitute the Aboriginal parties for cultural heritage issues and how much of it lies within their claim area.

On the basis of criteria specified in section 34 and 35 of the ACH Act, the following currently registered native title claims (in alphabetic order) have standing as exclusive Aboriginal parties for that portion of the project that falls within their claim boundaries (refer to **Figure 4-19**). Approximately 87% of the proposed pipeline route falls into this category

- Barada Barna (QC08/11, QUD380/08);
- Birri (QC98/12, QUD6244/98);
- Darumbal People (QC97/21, QUD6131/98);
- Darumbal #2 (QC99/1, QUD6001/99);
- Jangga (QC98/10, QG6230/98);
- Port Curtis Coral Coast (QC01/29, QUD6026/01); and
- Wiri People Core Country Claim (QC06/14, QUD372/06).

The following also have the status of exclusive Aboriginal parties that lie within an unregistered claim, but do not overlap with any currently registered claim. Approximately 3% of the proposed pipeline route falls into this category:

- Southern Barada & Kabalbara (QC00/4, Q60004/00);
- Wiri #2 (QC98/11, QG6251/98); and
- Barada Barna Kabalbara &Yetimarla People (QC01/13, QUD6011/01).

The Barada Barna Kabalbara and Yetimarla People claim overlaps with a section of the Wiri #2 claim.

No native title claim has been registered on three sections of the proposed pipeline route. The areas extend for a distance of 63 km, or just over 10% of the project area and fall between the registered claim areas for:

- Barada Barna and Darumbal People;
- Darumbal and Darumbal People #2; and
- Darumbal and Port Curtis Coral Coast People.

ARROW BOWEN PIPELINE PRELIMINARY ROUTE (REV D)

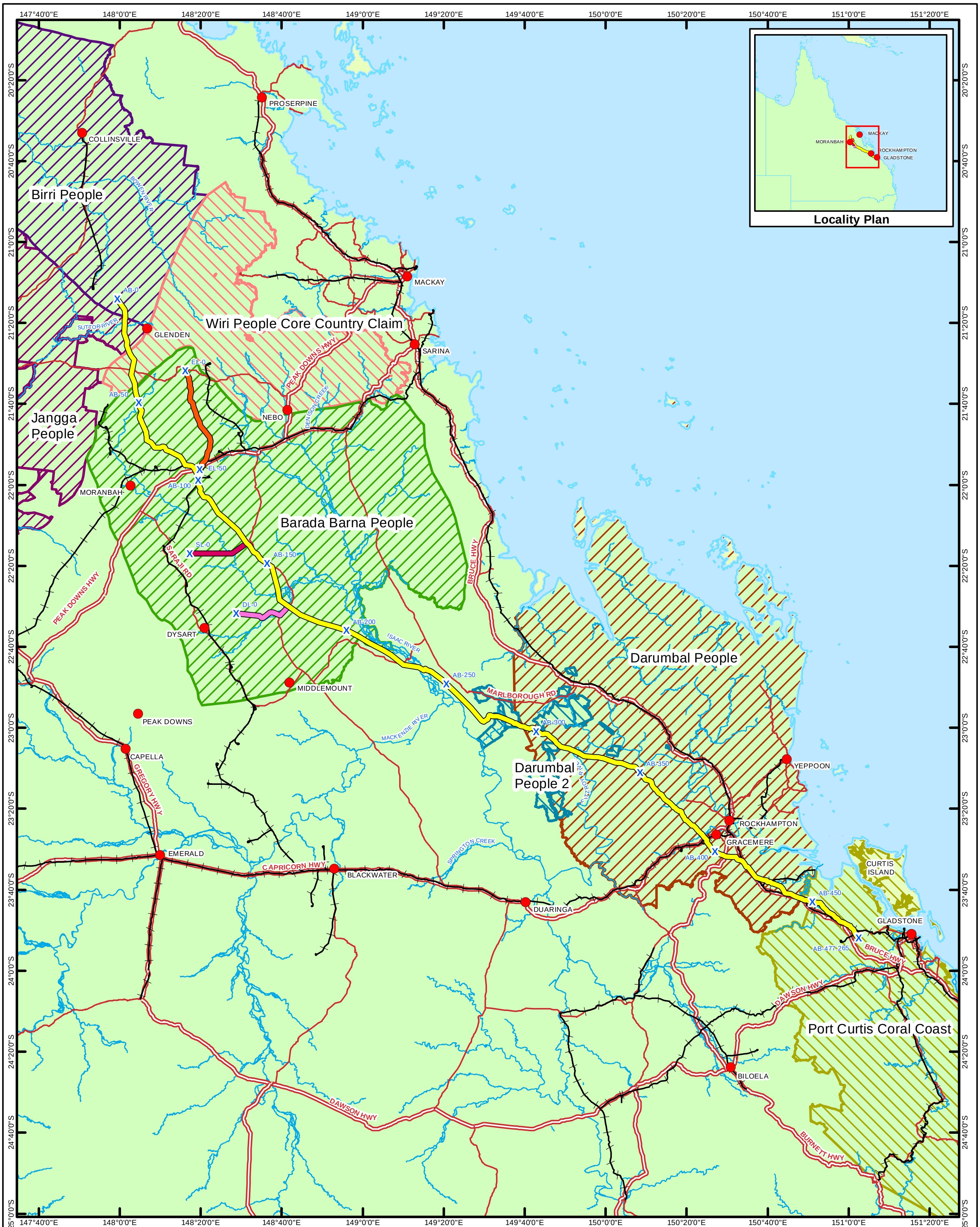


Figure 4 - 19: Native Title Determination Areas within the project area

Legend

- Localities
- Kilometre Points
- AB Mainline Rev D
- Dysart Lateral Rev D
- Elphinstone Lateral Rev D
- Saraji Lateral Rev D
- Railways
- Highways
- Major Roads
- Major Watercourses

NTDA Register (QLD)

- Barada Barna People
- Birri People
- Darumbal People
- Darumbal People 2
- Jangga People
- Port Curtis Coral Coast
- Wiri People Core Country Claim

Data Sources:
StreetPro: Localities, Roads, Railways
DERM: Major Watercourses
Data Supplied by Arrow Energy:
ABP Mainline RevD,
ABP Lateral RevD
Kilometre Points
National Native Title Tribunal: NTDA register (QLD)

Scale: 1:2,250,000 @ A4
Coordinate System: GCS GDA 1994

Document: I:\ENVR\Projects\EN02962\Spatial\ArcGIS\V1\Figure_4_19_Native_Titles_Determination_Areas_A4.mxd Date: 1/03/2012

NOT FOR CONSTRUCTION

4.9.1.2. Non-Indigenous historical cultural heritage

Queensland Heritage Register

Of the three places identified within a 5 km buffer either side of the proposed pipeline route identified in the QHR, only one place was identified within 1 km, as shown by the proximity Class in **Table 4-82**.

Table 4-82: Historical cultural heritage place types by proximity classes found within a 5 km buffer of the proposed pipeline route

Place ID	Place Name	Area (m^2)	Class
600388	Parson's Inn	174,206	1,000-2,500 m
600389	Raglan Homestead	587,492	100-250 m
600508	Gracemere Homestead	328,545	2,500-5,000 m

Source: Queensland Heritage Register

Raglan Homestead (QHR ID: 600389) is located approximately 160 m to the southwest of the AB mainline.

Cultural Heritage Information Management System

Separate to the QHR, DERM has compiled information regarding historic heritage places and incorporated this into its CHIMS. This database has been compiled from a comprehensive review of local histories, a wide range of heritage studies and a series of state-wide thematic studies on issues such mining and communication networks commissioned by DERM.

Analysis of CHIMS identified six additional places within a 5 km buffer either side of the proposed pipeline route. None are located within 1 km of the proposed pipeline route.

Local government planning schemes

Only Gladstone Regional Council (former Gladstone City Council and Calliope Regional Council areas) maintains separate heritage registers for historical cultural heritage.

A review of the relevant planning schemes for the Gladstone Regional Council was undertaken. Within the list of European historic heritage places, all but two of the ten listed places are already included within the QHR and are identified within the previous searches already described.

A review of the Local Heritage List within *The Gladstone Plan* found no places lying within the project area.

Commonwealth heritage list and register searches

The results of searches of Commonwealth heritage lists and registers within a 5 km buffer either side of the proposed pipeline route found that no historic places are located within 1 km of the proposed pipeline route.

Literature Review

A comprehensive literature review of pertinent historic sources was undertaken for the project. This included authoritative historical accounts of the region, local area histories, and numerous unpublished manuscripts held in the Capricornia Collection at the Central Queensland University.

Two previous studies are of direct relevance to the project including:

- A study of historical values associated with the Marlborough Nickel Project conducted in 1998; and
- A study of historical heritage commissioned for the Enertrade CQP undertaken in 2005.

Marlborough Nickel Project – historic heritage

The Marlborough Nickel Project lies in close proximity to the proposed pipeline route.

Places of potential historic significance identified included property homesteads, camping and water reserves, creek crossings, stock yards (including some associated with the short-lived sheep industry), gate posts of properties, historic roads and sundry buildings.

It was noted that whilst the history of the area is of some interest in terms of the opening up of this region by pastoral interests, the places recorded are not of state or national significance. None of these locations have been added to the CHIMS, or the QHR.

Central Queensland Gas Pipeline

A study of historical heritage for the CQP was commissioned in 2005. The section from Rockhampton south to Gladstone is largely paralleled by the proposed ABP route. Data received from DERM relating to the QHR indicated that there is only one listed place within 500 m of the project - Parsons Inn (QHR no. 600388).

4.9.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

The following provides an assessment of potential impacts on Indigenous and non-Indigenous cultural heritage and provides a range of mitigation measures to avoid or minimise impacts arising from the project.

The primary impacts on cultural heritage will occur during the construction phase. Disturbance or damage to cultural heritage may occur as a result of land clearance and excavations to accommodate the project and from the construction of temporary access routes, temporary workers' accommodation camps or storage areas.

4.9.2.1. Indigenous cultural heritage

The results of the desktop analysis for Indigenous cultural heritage identified a small number of known Aboriginal places and objects that are either situated within, or in close proximity to, areas that will be potentially disturbed by the project area. There is also the potential for additional Indigenous cultural heritage to be found.

Indigenous cultural significance

Direct engagement with all the Aboriginal parties is currently underway and had not been completed for the project at the time of preparing the EIS. As such, Arrow is still exploring the specific significance of the cultural places, object and values identified within the desktop searches and investigations.

Arrow is highly sensitive to Aboriginal parties and takes the responsibilities they have to their ancestors, spiritual entities and hero figures, and to the management and protection of the cultural heritage areas and objects they have inherited from them extremely seriously.

Scientific significance

The sites that have been identified and could potentially be affected by the project have some capacity to provide information on Aboriginal occupation. Potentially, they might provide information on the following:

- Settlement patterns of Aboriginal people;
- Source of stone used in artefact manufacture;
- Shell midden deposits and other stratified sites containing organic material such as charcoal deriving from cultural activities, which can be dated by using radiocarbon techniques to identify timing of occupation;
- Occupation deposits may also contain other organic remains of plants and animals that were used by Aboriginal people, and give information insights into subsistence economy, seasonality of occupation and related matters; and

- The stone artefacts and any tools made of material such as bone or wood can provide information on aspects of technology.

Proposed Indigenous cultural heritage strategy

The Aboriginal parties retain a strong interest in ensuring that the cultural heritage places and objects identified throughout the project area are managed in a culturally-appropriate fashion, and with their direct input. Wherever possible, this will be carried out by conservation of the area or objects in-situ and avoidance of impacts.

However, where impacts are unavoidable, the controlled removal and storage of cultural objects in locations acceptable to the native title parties will be necessary, given the constraints that will operate on the project. It has been anticipated that the native title parties will require a management process that embodies culturally appropriate mechanisms for the management of their cultural heritage, along with the conclusion of an ILUA that provides compensation for the suppression of their native title interests.

Arrow Energy recognises the Aboriginal parties‘ strong interest in ensuring that the cultural heritage areas, objects and values identified throughout the project area are protected or managed in a culturally appropriate fashion, and with their direct input. It is anticipated that the Aboriginal parties will require the implementation of a management process that embodies culturally appropriate mechanisms for the protection or management of their cultural heritage.

The Aboriginal Cultural Heritage Act duty of care for the project can be met through either a suitable native title agreement that does not expressly exclude cultural heritage, such as an ILUA, or an approved CHMP under Part 7 of the ACH Act.

Arrow Energy‘s preferred approach is by settlement of agreements with native title parties. Arrow Energy will agree to situate Aboriginal cultural heritage agreements within the framework of ILUAs to be negotiated with the native title parties, but only where this is the formally expressed wish of the relevant native title party. Where this is not the case, Arrow Energy will develop a CHMP.

If an ILUA cannot be completed in accordance with the project timetable, or is not registered, Arrow Energy will be required to comply with Part 7 of the Aboriginal Cultural Heritage Act in another manner (i.e. development of a CHMP for approval by the Chief Executive of DERM).

With this in mind, it is proposed to develop a CHMP in parallel with the negotiation of an ILUA to ensure that the project is compliant with the duty of care irrespective of outcomes in the sphere of native title. Arrow Energy has issued two notices to develop CHMPs for the project in accordance with Part 7 of the ACH Act.

The process and timeframes for finalising the CHMP or native title agreement are being agreed with the relevant Aboriginal parties and native title applicants. Arrow Energy intends to have these agreements finalised prior to the financial investment decision for the project.

Therefore, Arrow Energy's commitments to Aboriginal cultural heritage include:

- Development of an approved CHMP or a native title agreement that addresses Aboriginal cultural heritage in consultation with the endorsed Aboriginal parties/native title parties for the project; and
- Compliance with the approved CHMP or native title agreement that addresses Aboriginal cultural heritage will constitute Arrow Energy's compliance with the Aboriginal Cultural Heritage Act duty of care.

Native title parties and negotiation status

Arrow has implemented a native title and cultural heritage compliance strategy for the project.

Voluntary agreements in the form of ILUAs are currently underway, to resolve both native title interests and to provide the necessary consents to comply with the ACH Act. This strategy also applies for areas that currently have no registered Native Title Determination Applications (NTDA). For these areas, relevant native title interests will be identified by research and public notification processes.

Based on the outcome of the tenure analysis, Arrow Energy commenced formal negotiations towards voluntary agreements in 2010 with all the registered Native Title Claimants. In 2011, informal discussions commenced with former registered Native Title Claimants in the unclaimed areas.

Registered native title parties

Arrow Energy has concluded ILUAs with the following registered native title parties for the relevant parts of the project which traverses land or waters in which they assert an interest:

- Birri People (QUD6244/98, QC98/12);
- Jangga People (QUD6230/98, QC98/10);
- Wiri People (QUD372/06, QC06/14); and
- Barada Barna People (QUD380/08, QC08/11).

Authorised ILUAs with all of the above groups have been presented to the National Native Title Tribunal (NNTT) for registration, which is anticipated before the end of 2011.

Active negotiations towards ILUAs are continuing with two additional registered Native Title parties:

- Port Curtis Coral Coast People (QUD6026/01, QC01/29); and
- Darumbul People (QUD6131/98, QC97/21 and QUD6001/99, QC99/1);

It is anticipated that a voluntary agreement will be concluded with the above two groups in the near future.

Parties for unclaimed areas

For the three areas of the project which are not subject to a current NTDA, Arrow has engaged in a process of enquiry and public notification to identify the relevant Native Title parties. In some cases, there were formally registered Native Title claimants for the areas in question. Relevant parties have been identified for each of these areas, and negotiations towards ILUAs and cultural heritage agreements have commenced.

General Form of Cultural Heritage Arrangements

Arrow Energy is committed to adopting a range of principles to apply to cultural heritage management. Ultimately, the ILUA or approved CHMP will form the governing document for project compliance with the Aboriginal Cultural Heritage Act.

The general form of the cultural heritage arrangements under either the ILUA or approved CHMP will contain:

- A set of overarching principles. Provisions relating to the ownership of Aboriginal cultural heritage, management of cultural heritage information, dispute resolution and general administrative arrangements;
- Conduct of an Initial Cultural Heritage Assessment. To date, only targeted, onsite inspections related to the geotechnical investigations have been conducted. The CHMP will provide for additional detailed field surveys to identify Indigenous cultural heritage places or objects located within the project area. Surveys will be carried out prior to construction proceeding;
- Development of Cultural Heritage Management Strategies. Provisions for establishing agreed strategies that detail how significant areas and objects identified during the Initial Cultural Heritage Assessment will be managed during project construction. Avoidance of Indigenous cultural heritage places will be the preferred strategy should this be technically feasible. Where there is no flexibility to avoid a site, the loss will be offset by a suitable program of mitigation that collects and preserves the data that a site may hold for future research purposes. Provisions will be made for cultural induction processes, the development of a cultural awareness program, procedures for accidental discovery of cultural material and accidental discovery of human remains, and management of cultural heritage material, conflict resolution and other contingencies;
- Establishment of a Post-construction Heritage Agreement. Provisions related to developing, if necessary, formal agreements detailing ongoing management arrangements for cultural places during the operational phase of the project.

Arrow Energy proposes to adopt to the greatest extent possible an agreement-based process with the Aboriginal parties for authorisation of all project activities that may harm cultural heritage.

Cultural heritage arrangements under negotiation seek to involve the Aboriginal parties in all aspects of management through the establishment of a coordinating committee that has a membership of representatives of the Aboriginal parties. Decisions on the management of cultural heritage will be made by consensus between Arrow Energy and the coordinating committee.

Refinements to proposed pipeline route

Arrow's management principles relating to Aboriginal cultural heritage fully recognise that the Aboriginal parties retain a strong interest in ensuring that the cultural heritage places and objects identified in the project area are managed in an appropriate fashion and with the direct input of the Aboriginal parties. Wherever possible, this will be done either by conservation of the area or object(s) in-situ or avoidance by adjustments to the proposed pipeline route.

Where feasible, adjustments to the proposed pipeline route will be investigated within a 100 m wide survey corridor. Surveys will be commissioned in a timely fashion to allow for the inclusion of all relevant data in final alignment design.

4.9.2.2. Non-Indigenous historical cultural heritage

The results of the desktop analysis found that the project area contains relatively low levels of historic cultural heritage significance.

A search of the QHR identified Raglan Homestead (QHR ID:600389) which is located approximately 160 m to the southwest of the AB mainline. This property will not be impacted by the project.

Historical heritage survey

The results of the desktop review will be supplemented by field surveys of the proposed pipeline to be undertaken by March, 2012. The purpose of the surveys will be to identify all possible places of historical heritage value, assess them against relevant literature, make an assessment of their value against the criteria in the QH Act and prepare management strategies, in consultation with DERM.

A TOR for the study will be developed in direct consultation with DERM and undertaken by suitably qualified personnel. The results of the survey and recommended management measures will be reported. A management plan for each place identified will be developed and settled in consultation with DERM.

Historic Heritage Management Plan

A draft HHMP for the project is presented in an appendix of the *Cultural Heritage Impact Assessment* included in **Appendix A4.15**, **Volume 3**. The HHMP captures the commitments made for the conduct of the historical heritage study and the principles that will inform management.

The HHMP forms part of the project's EMP (**Chapter 5**). As a minimum, the following issues are addressed within the HHMP:

- Processes for the mitigation, management and protection of identified historic cultural heritage places and values during execution of the construction, operational, rehabilitation and decommissioning phases of the project;
- Processes for reporting, as required by section 89 of the QH Act, the discovery of any archaeological artefact not previously identified in the historic cultural heritage study;
- Procedures for the collection of any artefact material, including appropriate storage and conservation;
- Historical cultural heritage awareness training or programs for project staff. This will include, but may not be limited to:
  - an introduction to the legislative framework for historic heritage in Queensland with particular reference to the project;
  - the agreed management actions or strategies implemented for both identified and potential historic heritage places and values;
  - the particulars of this HHMP as it relates to their activities, as well as their responsibilities and obligations under the Plan.

The draft HHMP will be forwarded to relevant sections within DERM for their review and comment. Any comments received will be addressed in a revised version of the HHMP, which will then be forwarded to DERM for formal endorsement. The approved HHMP will then be implemented for the project.

4.9.3. SUMMARY

Indigenous cultural heritage

A native title and cultural heritage compliance strategy has been initiated by Arrow to voluntarily resolve native title interests. Over 200 km of the project is subject to authorised ILUAs with relevant registered native title parties. The remaining areas are subject to active ILUA negotiations.

No places within a 1 km buffer either side of the proposed pipeline route were identified from a review of Commonwealth heritage lists and registers. However, a search of the ICHRD returned 75 entries that are located within a 1 km buffer of the proposed pipeline route

The development of a CHMP or a suitable native title agreement that does not expressly exclude cultural heritage, such as an ILUA, in consultation with Aboriginal Parties will ensure the protection and management of cultural areas, object and values identified during cultural heritage surveys with the involvement of Aboriginal parties.

Arrow Energy will seek to develop an approved CHMP or a native title agreement that addresses Aboriginal cultural heritage in consultation with the endorsed Aboriginal parties for the project. Compliance with the approved CHMP or native title agreement that addresses Aboriginal cultural heritage will constitute Arrow Energy's compliance with the Aboriginal Cultural Heritage Act duty of care.

Non-Indigenous cultural heritage

The results of the desktop analysis found no sites listed on the Commonwealth heritage lists or registers within the project area. One site listed on the QHR is located outside the project area and will not be impacted.

To mitigate potential impacts on historic heritage values, a draft HHMP has been developed and will be implemented as part of the project EMP. With the implementation of appropriate mitigation, it is anticipated that the residual impacts on non-Indigenous cultural heritage will be minor and manageable.

The key commitments with respect to cultural heritage are summarised in **Table 4-83**.

Table 4-83: Project commitments for cultural heritage

Potential Impacts	Commitments
Indigenous cultural heritage values	▪ Finalise the ongoing consultation process to settle ILUAs with two registered native title parties. ▪ For Unclaimed Areas, continue the ongoing consultation process for the three areas which are not subject to a current NTDA.
	Develop and implement CHMP in conjunction with Aboriginal parties
Non-Indigenous cultural heritage values	Finalise field surveys of non-Indigenous cultural heritage during 2012.
	Implement the HHMP as part of the project EMP.

4.10. SOCIAL VALUES

This section provides an assessment of the potential social impacts and benefits of the project, including an assessment of potential changes to surrounding communities and landholders, resulting from the construction and operation of the project. Possible mitigation measures are also identified to maximise the benefits and minimise the impacts of the project for local and regional communities.

A *Social Impact Assessment* (SIA) and a *Social Impact Management Plan* (SIMP) have been prepared to assess and to guide the management of social impacts identified through the EIS (refer to **Appendix A4.2**, **Volume 3)**.

Legislation, policies and guidelines

The assessment of social values associated with the project is based on relevant legislation, policies and guidelines outlined in **Table 4-84**.

Table 4-84: Legislation, policies and guidelines

Legislation, policy and guideline	Relevance
Sustainable Resource Communities Policy 2008	▪ Seeks to strengthen the SIA component of the EIS process for the mining and petroleum industry to enable the delivery of positive community outcomes, including the consideration of cumulative and regional impacts in decision making and planning for communities. The Social Impact Management Plan (SIMP) must be prepared in accordance with the Social Impact Management Plan Guideline that was adopted by the Queensland Government in 2010 (Department of Infrastructure and Planning 2010).
Regional plans	▪ The regional plans relevant to social values the *Draft Mackay, Isaac, Whitsunday Regional Plan* and the *Central Queensland Regional Plan* (Central Queensland Regional Growth Management Framework). Refer **Section 1.5.2.6**.
Local Planning Schemes	▪ The proposed pipeline route traverses land included within seven local government planning schemes. Refer **Section 1.5.1.3**.

Methodology

The potential social impacts and identification of possible mitigation measures associated with the project have been based on:

- The definition of the project area which may potentially be impacted by the project;
- The scoping of likely issues, including the nature of and extent of the project‘s potential benefits and impacts and potentially affected groups or communities;

- A description of the existing social environment and social values of the project area, including the baseline conditions of potentially affected groups or communities;
- An identification and analysis of the potential benefits and impacts for particular communities and assessing the magnitude, duration and likelihood of the identified benefits and impacts; and
- An identification of mitigation strategies to enhance benefits of the project and to avoid or minimise impacts.

The description of the existing social environment provides an overview of key social characteristics and conditions in the project area, including population and demography, social infrastructure and community values. This has been based on:

- A review of demographic data from the 2006 Australian Bureau of Statistics (ABS) Census for the Statistical Local Areas (SLAs) of Bowen, Nebo, Belyando, Broadsound, Livingstone (Part A and Part B), Fitzroy (Part A and Part B), Calliope (Part A and Part B), supplemented by information from state and local government departments (information from the 2011 Census is expected to be available from mid-2012).
- A review and analysis of relevant literature and data relating to local community values;
- An analysis of existing social infrastructure in the project area, including housing, community, sport, recreation and leisure, cultural, education and health services and facilities; and
- A review of the outcomes of consultation with local communities and key stakeholders including local and state government departments, undertaken by Arrow.

Potential benefits and impacts on the social environment of local and regional communities in the project area were identified and evaluated. This included an analysis of the potential benefits and impacts of the project‘s construction, operation and decommissioning on community values, population size and characteristics, housing and accommodation, access and connectivity, local business and industry, employment and social infrastructure.

4.10.1. DESCRIPTION OF EXISTING SOCIAL VALUES

4.10.1.1. Project area

The project area for the purposes of assessing the social environment and impacts includes the SLAs of:

- Bowen;
- Nebo;
- Belyando;
- Broadsound;
- Livingstone (Part A and Part B);
- Fitzroy (Part A and Part B); and
- Calliope (Part A and Part B).

These SLAs encompass a number of main centres and townships located along the proposed pipeline route which have also been considered as part of this assessment.

4.10.1.2. Existing social values

This section provides an overview of the demographic and population profile of local and regional communities, social infrastructure including facilities and housing, and local community values within the project area. Further information is provided in **Appendix A4.2**, **Volume 3**.

Population size, age and mobility

A summary of the project area's estimated population size (2010), age profile and population mobility (2006) is provided in **Table 4-85**.

Table 4-85: Population and age

Statistical local area	Estimated resident population 2010	Aged 14 years or under (%)	Aged 15 years to 64 years (%)	Aged 65 years or over (%)	Median age (years)	Same address 5 years previously (%)
Bowen	14,391	18.0	68.5	13.5	31	47.7
Nebo	2,994	21.1	75.0	3.9	33	29.8
Belyando	12,113	25.4	70.7	3.9	30	39.8
Broadsound	7,522	25.6	69.8	4.6	32	38.5
Livingstone (Part A)	4,689	18.6	73.3	8.1	35	47.0
Livingstone (Part B)	29,572	19.9	65.3	14.8	41	44.4

Statistical local area	Estimated resident population 2010	Aged 14 years or under (%)	Aged 15 years to 64 years (%)	Aged 65 years or over (%)	Median age (years)	Same address 5 years previously (%)
Fitzroy (Part A)	8,408	27.4	63.7	8.9	33	43.3
Fitzroy (Part B)	4,874	21.3	66.2	12.5	39	55.3
Calliope (Part A)	17,147	24.5	66.7	8.8	35	42.2
Calliope (Part B)	3,091	23.3	66.2	10.5	39	51.1
Project area	104,801	22.2	67.5	10.3	not available	43.9
Queensland	4,513,850	20.0	67.4	12.6	36	45.1

Source: ABS 2006 Census of Population and Housing

Population size and growth

In 2010, the project area had an estimated residential population of 104,801 people. Livingstone (Part B) has the largest population, with an estimated 29,572 people, followed by Calliope (Part A) (17,147 people) and Bowen (14,391 people). Nebo SLA had the smallest population with 2,994 people.

Between 2005 and 2010, the combined population of SLAs in the project area increased by an average of 2.9% per annum, which was slightly higher than the rate of population growth for Queensland as a whole. This was driven by relatively high population growth in Fitzroy (Part A) (at 6.4%), Calliope (Part A) (at 4.1%), Livingstone (Part A) (at 3.7%) and Nebo (at 3.4%). Over the 12 months to 2010, the rate of population growth in the project area slowed, largely due to negative growth in the SLAs of Broadsound and Fitzroy (Part B). Fitzroy (Part A) was the only SLA that experienced population growth higher than Queensland as a whole between 2009 and 2010.

By 2031, the population of the project area is expected to increase to approximately 180,000 people, or by approximately 2.6% annually. This is higher than the average rate of growth expected for Queensland as a whole (at 1.8% per annum).

Age profile

As shown in **Table 4-85** the project area had a higher proportion of children aged 14 years or under and lower proportions of people aged 65 years or over compared to Queensland as a whole. In 2006, the proportion of people in the project area aged 15-64 years was comparable to Queensland.

The SLAs of Belyando and Broadsound had particularly high levels of children, with more than 25% of the population of each SLA aged 14 years or under. This is compared to 23.3% in the project area and 20% in Queensland as a whole. The SLAs of Livingstone (Part B) and Bowen had relatively high proportions of older people, with 14.8% and 13.5% of people in these SLAs respectively aged 65 years or over. This reflects the higher median ages of these two SLAs.

Population mobility

The project area had a slightly more transient population compared to Queensland with higher proportions of people living elsewhere five years prior to the 2006 Census (refer to **Table 4-85**). In particular, this was driven by high levels of population mobility in the SLAs of Nebo (at 29.8%), Broadsound (at 38.5%) and Belyando (at 39.8%). Fitzroy (Part B) and Calliope (Part B) had relatively low levels of population mobility over the five years to 2006.

4.10.1.3. Cultural diversity

Overseas born and language

In 2006, the project area had relatively low levels of cultural diversity compared to Queensland with lower proportions of people born overseas and people who spoke a language other than English. SLAs with relatively high proportions of people born overseas compared to the project area as a whole included Calliope (Part A), Bowen and Livingstone (Part B). Bowen also had the highest levels of people who spoke a language other than English of the project area SLAs.

Indigenous population

There were 3,126 people in the project area identified as being indigenous at the 2006 Census. This represented approximately 3.5% of the project area population, which was comparable to Queensland as a whole (at 3.3%). SLAs with relatively high levels of Indigenous people included Fitzroy (Part A), Bowen and Livingstone (Part A).

The median ages of Indigenous people in the former LGAs[8] traversed by the project area ranged from 15 years in the former Fitzroy LGA to 24 years in the former Bowen LGAs. This is compared to a median age of 20 years for indigenous people in Queensland as a whole.

In 2006, indigenous people in the former LGAs traversed by the project area generally had lower levels of unemployment compared to Indigenous people in Queensland as a whole. However, the level of unemployment amongst Indigenous people in the project area was considerably higher than the level for Queensland's total population (4.8%), apart from the

[8] This refers to LGAs in existence prior to 15 March 2008. The LGA boundaries generally relate to the SLA boundaries, apart from Calliope, Livingstone and Fitzroy which include Part A and Part B of the respective LGAs.

former Broadsound LGA which had an indigenous unemployment rate of approximately 4.2%.

Indigenous people in each former LGA traversed by the project area, with the exception of Livingstone, had higher median incomes than indigenous people in Queensland as a whole. In particular, Indigenous people in the former LGAs of Broadsound, Belyando and Nebo had relatively high median individual incomes compared to Queensland.

A summary of key socio-economic characteristics of the indigenous population in the LGAs traversed by the project area is provided in **Table 4-86**.

Table 4-86: Indigenous population characteristics, 2006

Characteristic	Bowen	Nebo	Belyando	Broadsound	Livingstone	Fitzroy	Calliope	Queensland
Population	805	67	192	165	975	514	402	127,581
Males (no.)	422	38	98	93	579	324	211	62,689
Male (%)	52.4	56.7	51.0	56.4	59.4	63.0	52.5	49.1
Females (no.)	383	29	94	72	396	280	191	64,892
Female (%)	47.6	43.3	49.0	43.6	40.6	54.5	47.5	50.9
Median age	24	23	21	17	21	15	17	20
Employment (%)	49.9	71.7	62.3	69.4	33.8	47.9	54.1	48.9
Unemployment (%)	12.8	15.4	8.0	4.2	9.8	14.3	8.8	13.1
Median individual income ($)	351	559	506	683	280	367	318	318
Median household income ($)	774	1,831	1,599	1,985	848	884	1,257	899
Median weekly rent ($)	135	52	60	51	165	140	170	150

Source: ABS, 2006 Census of Population and Housing, cat. no. 2001.0, Community Profile Series

4.10.1.4. Family and households

A summary of family and households in the project area is provided in **Table 4-87**. In 2006, there were approximately 23,000 families in the project area of which approximately 40% comprised couple only families. Nearly 59% of households comprised families with children, including couples with children and one parent families. Overall, one parent families comprised a relatively small proportion of total families in the project area (at 11.4%) compared to Queensland (at 15.9%).

Calliope (Part B), Bowen and Livingstone (Part B) had relatively high proportions of couple families without children, while Fitzroy (Part B) and Belyando had relatively high proportions of families with children, compared to the project area and Queensland.

There were approximately 29,211 households in the project area at the 2006 Census, of which approximately 77.2% comprised family households. All SLAs in the project area, with the exception of Bowen, had higher proportions of family households compared to Queensland.

The project area had a slightly larger average household size compared to Queensland as a whole. Livingstone (Part A) had the largest household size at 3.2 people per household, followed by Fitzroy (Part A) and Calliope (Part A), which both had 2.9 people per household.

Table 4-87: Family and households, 2006

Statistical local area	Couple only families (%)	Families with children* (%)	Total families (No)	Family households (%)	Non-family households (%)	Total households (No)	Average household size (people / household)
Bowen	45.9	52.6	3,094	68.6	31.4	4,440	2.4
Nebo	36.8	62.0	505	76.5	23.5	647	2.8
Belyando	34.2	64.8	2,570	77.4	22.6	3,281	2.8
Broadsound	36.5	62.6	1,633	78.6	21.4	2,053	2.8
Livingstone (Part A)	36.3	63.2	994	93.0	7.0	1,048	3.2
Livingstone (Part B)	45.7	53.4	6,733	74.2	25.8	8,916	2.5
Fitzroy (Part A)	33.7	65.8	1,657	83.2	16.8	1,962	2.9
Fitzroy (Part B)	43.0	56.4	1,164	81.1	18.9	1,405	2.8
Calliope (Part A)	36.1	63.4	3,824	83.1	16.9	4,524	2.9
Calliope (Part B)	46.5	53.5	753	78.9	21.1	935	2.7
Project area	40.6	58.6	22,927	77.2	22.8	29,211	2.8
Queensland	39.1	59.2	1,032,034	72.7	27.3	1,391,634	2.6

* Note: includes couple families with children and one parent families

Source: ABS, 2006 Census of Population and Housing, cat. no. 2001.0, Community Profile Series

4.10.1.5. Employment and economic resources

In 2006, there were approximately 42,000 people in the project area aged 15 years or over that were either employed or looking for work. Overall, the project area had a relatively low rate of unemployment compared to Queensland as a whole. Livingstone (Part A) had the lowest rate of unemployment (at 1.8%), followed by Belyando (at 2%) and Broadsound (at 2.3%). Calliope (Part B) and Livingstone (Part B) were the only two SLAs that had rates of unemployment above Queensland as a whole. In 2011, while the unemployment rate for the project area had increased slightly from the 2006 Census, it remained below the unemployment rate for Queensland as a whole. Livingstone (Part B) and Calliope (Part B) continued to have relatively high levels of unemployment compared to Queensland as a whole.

Mining was a key employer in the project area, with approximately 22% of the workforce employed in mining. This is compared to approximately 2.8% in Queensland. Construction and manufacturing were also key employers in the project area. Calliope (Part A and Part B), Livingstone (Part B), and Fitzroy (Part B) had relatively high levels of people employed in construction compared to the project area and Queensland as a whole.

In 2006, households in the project area had relatively high weekly incomes, with many of the project area SLAs recording median weekly household incomes equal to or above those for Queensland as a whole. In particular, Belyando, Broadsound and Nebo had very high median household incomes, which is likely to reflect the very high levels of mining workers in these SLAs. The project area also had relatively high individual incomes compared to Queensland as a whole as shown in **Figure 4-20**.

A number of SLAs in the project area displayed levels of relative socio-economic disadvantage and low levels of economic resources. In particular, Bowen had the highest levels of socio-economic disadvantage higher proportions of people on low incomes, lower levels of education, and fewer professionals. Bowen also had the lowest levels of economic resources of the project area SLAs. Communities that display levels of relative disadvantage or low levels of economic resources are likely to be more vulnerable to the impacts of large infrastructure projects than those that display levels of relative advantage. Although improved access to employment opportunities would provide benefits for those communities that display levels of relative disadvantage.

A summary of key employment and economic resources data relevant to the project area is provided in **Table 4-88**.

Table 4-88: Employment and economic resources, 2006

Statistical local area	Unemployment (%)	Employed in mining (%)	Employed in construction (%)	Employed in other industry (%)	Relative socio-economic Disadvantage	Economic resources
Bowen	4.6	14.9	15.7	69.4	928	961
Nebo	2.4	49.8	9.7	40.5	1022	1032
Belyando	2.0	59.2	9.0	31.9	1049	1064
Broadsound	2.3	68.0	9.5	22.5	1029	1038
Livingstone (Part A)	1.8	8.1	12.5	79.4	1079	1110
Livingstone (Part B)	4.9	8.5	18.8	72.8	991	995
Fitzroy (Part A)	4.2	7.2	13.9	78.9	982	996
Fitzroy (Part B)	3.5	9.4	17.0	73.6	992	1026
Calliope (Part A)	4.2	3.0	19.0	77.9	1037	1054
Calliope (Part B)	5.1	3.9	21.4	74.7	957	1006
Project area	3.8	22.0	15.3	62.7	1007	1028
Queensland	4.7	2.8	15.0	82.2		

Source: ABS, 2006 Census of Population and Housing, cat. no. 2001.0, Community Profile Series

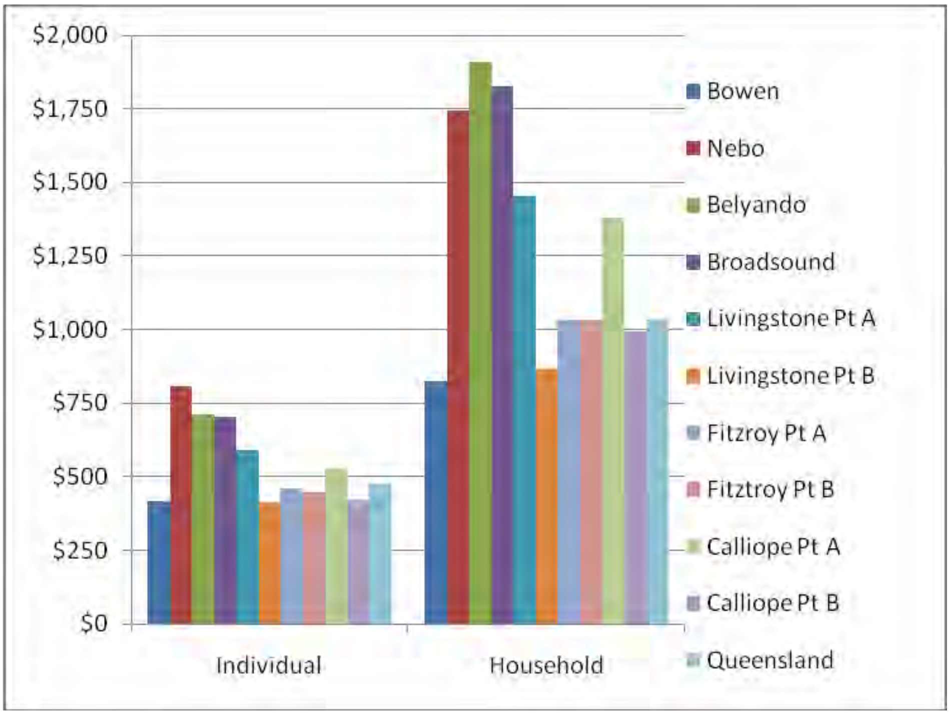


Figure 4-20: Median individual and household income, 2006

4.10.1.6. Housing and accommodation

A summary of dwelling type and tenure for the project area at the 2006 Census is provided in **Table 4-89**. There were approximately 29,193 occupied private dwellings in the project area at the 2006 Census of which, approximately 87.5% comprised separate houses. All SLAs apart from Bowen had a significantly higher rate of separate houses compared to Queensland as a whole. The project area also had relatively high proportions of other dwellings, such as caravans, cabins, improvised home, tents, houses or flat attached to a shop. In particular, approximately 11.5% of dwellings in Nebo were classified as an -other dwelling". This may reflect the presence of workers accommodation camps associated with mines in this SLA.

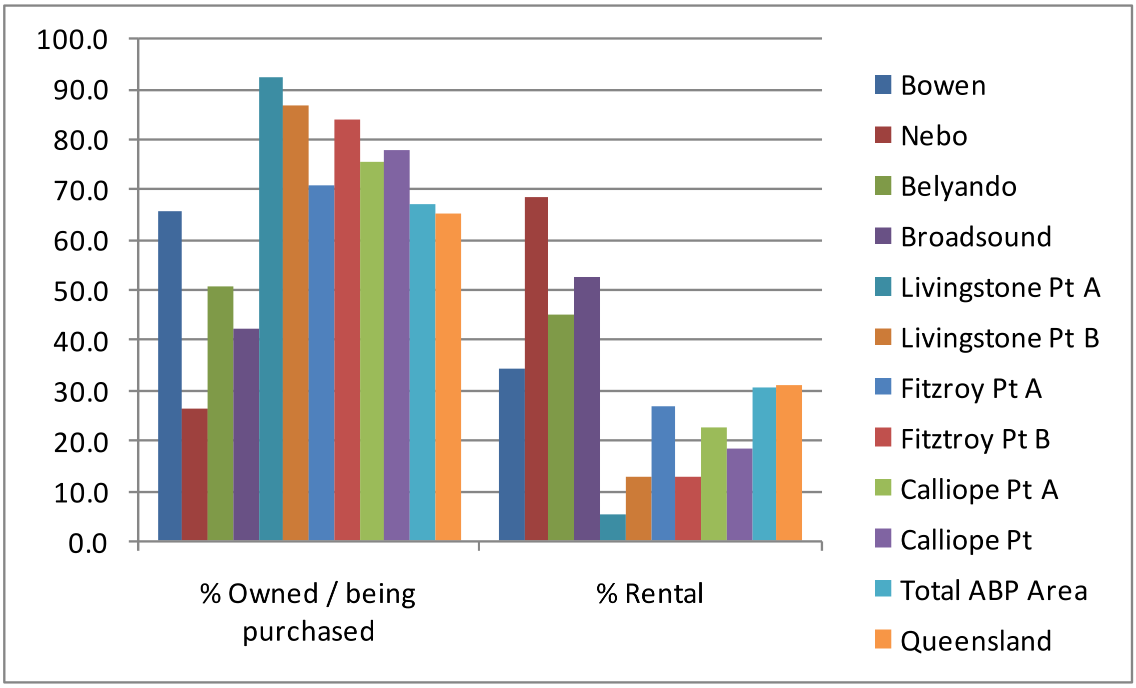
In 2006, the project area had slightly higher proportions of dwellings that were either owned or being purchased, compared to Queensland as a whole as shown in **Figure 4-21**. However, this was driven by particularly high rates of owner occupiers in a few SLAs such as Livingstone (Part A and Part B), Fitzroy (Part B) and Calliope (Part B). Nebo had very low rates of owner occupiers (at 26.2%) and conversely high rates of rental houses (at 68.4%), which is consistent with the high proportion of -other dwellings" in this location.

The project area had rates of rental housing similar to Queensland. However, Nebo, Belyando and Broadsound had very high rates of rental housing at 68.4%, 45.2% and 52.8% respectively. This is likely to be associated with the higher proportion of mining workers in these SLAs and more transient populations. Livingstone had a very low rate of rental housing (at 5.2%), compared to Queensland (at 31.1%).

Table 4-89: Dwelling type and tenure

Statistical local area	Separate houses (%)	Other dwelling (%)	Total dwellings
Bowen	75.5	6.7	4,440
Nebo	86.5	11.5	646
Belyando	90.0	4.4	3,278
Broadsound	92.3	3.7	2,053
Livingstone (Part A)	98.7	1.0	1,047
Livingstone (Part B)	85.6	4.4	8,915
Fitzroy (Part A)	94.9	2.5	1,957
Fitzroy (Part B)	96.6	2.1	1,402
Calliope (Part A)	89.5	5.4	4,524
Calliope (Part B)	94.0	4.2	931
Project area	87.5	4.6	29,193
Queensland	79.5	1.5	1,391,632

Source: ABS, 2006 Census of Population and Housing, cat. no. 2001.0, Community Profile Series



Source: ABS, 2006 Census of Population and Housing, cat. no. 2001.0, Community Profile Series

Figure 4-21: Housing ownership and rental by SLA, 2006

Median house sale prices across the project area have increased considerably over recent years, largely due to the increased demand for housing from workers in the mining and resources industries. While the increase in house prices has slowed in recent years across many towns and regions in the project area, over the five years to the March 2011 quarter, many towns and regions recorded changes in house prices above 50%. In particular, Dysart recorded a change in median house prices over the five years of approximately 109%, while Calliope recorded a change in median house prices over the five years of approximately 92%. This is compared to changes in median house prices over the five years to the March 2009 quarter of approximately 737% and 127% for these locations respectively (REIQ 2009, 2010 and 2011).

4.10.1.7. Social infrastructure

Community infrastructure includes services, facilities and networks which support community well-being. Communities in the project area and along the pipeline corridor generally have varying levels of access to infrastructure, with the larger towns having the most sufficient access. Specialist health services, higher education, and some entertainment and leisure facilities are only accessible at regional centres.

The majority of social infrastructure in the project area is generally concentrated within major towns such as Moranbah, Gracemere and Calliope. In particular:

- There are 17 child care facilities, of which five are located at Moranbah, four at Gracemere, three at Calliope, two at Dysart and one at each of Glenden, Middlemount, and Bouldercomb;
- There are 16 state schools in communities along the pipeline route, including 11 primary schools, two secondary schools and three combined primary / secondary schools. In addition, one catholic primary school is located at Gracemere;
- The project area is served by a range of emergency services, including police, ambulance and fire. The Livingstone (Part A) SLA does not have any emergency services facilities, with residents likely to access these services within nearby SLAs;
- There are seven hospitals located in the project area, with Bowen, Belyando and Livingstone (Part B) all having two hospitals and Broadsound having one; and
- The project area includes a range of national parks, state forests, timber reserves and forest reserves.

A number of community facilities are also located within approximately 10 km of the proposed pipeline route, including 12 state schools, emergency services, recreation facilities and aged care.

4.10.1.8. Local community values

The project area is primarily rural and made up of agricultural land. These communities generally tend to consist of properties that are passed down over generations. The loss of agricultural land in these communities is a primary concern for many residents. The rural landscape and amenity lend themselves to a quiet lifestyle that is likely to be valued by the community.

A number of significant social facilities that are likely to be accessed frequently and which are likely to be important to local communities are located within a 10 km radius of the pipeline. They include two cemeteries (one in Gracemere), two libraries and four churches.

Volunteering is a good indicator of a community‘s sense of cohesiveness and harmony. The project area had relatively high levels of volunteering (at 21.0%) compared to Queensland (at 18.3%) indicating a slightly higher level of social cohesion. However, Nebo (15.2%) and Bowen (17.6%) residents had the lowest levels of participation in volunteering compared to other SLAs in the project area and Queensland (refer **Table 4-90**).

Table 4-90: Volunteering, 2006

Statistical local area	Volunteers (%)	Does not volunteer (%)	Not stated
Bowen	17.6	66.7	15.7
Nebo	15.2	61.2	23.6
Belyando	24.4	66.1	9.5
Broadsound	22.9	61.5	15.7
Livingstone (Part A)	18.7	60.4	20.9
Livingstone (Part B)	21.5	68.6	9.9
Fitzroy (Part A)	19.2	71.0	9.7
Fitzroy (Part B)	20.6	66.3	13.1
Calliope (Part A)	22.5	69.4	8.1
Calliope (Part B)	22.6	69.9	7.5
Project area	21.0	67.1	11.8
Queensland	18.3	72.1	9.6

Source: ABS, 2006 Census of Population and Housing, cat. no. 2001.0, Community Profile Series

4.10.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

The following describes the potential benefits and impacts on the social environment of the project area from the construction and operation of the proposed pipeline. Mitigation measures are also identified to manage potential adverse impacts on the project's construction and operation for local and regional communities.

4.10.2.1. Property impacts

An easement wil be required to allow the construction, operation and maintenance of the gas pipeline. The easement for the proposed pipeline will be 30 m wide and will extend the length of the pipeline. During construction, a ROW will be established along the length of the route to allow safe construction of the buried pipeline.

The proposed pipeline route crosses 232 separate lots as shown in **Table 4-91**. The majority of the proposed pipeline route crosses freehold land.

Table 4-91: Land tenure

Type of tenure	Lots / Land Parcels
Freehold	205
Land Lease	23
Reserves	4
Total	**232**

Source: Arrow Energy, 2011 Landowners Database

The proposed pipeline crosses a total of 90 easements as shown in **Table 4-92**.

Table 4-92: Easements

Type of tenure	Lots / Land Parcels
Mainline easement (road/ rail/water)	87
Laterals easement (road/ rail/water)	3
TOTAL	**90**

Source: Arrow Energy, 2011 Landowners Database

Potential impacts of the project on property would generally relate to the temporary disruption to the use of land within the ROW during construction after which the land use reverts to its former use. The final alignment for the proposed pipeline will be determined in conjunction with landholders, which will help to minimise impacts on the use of land and other activities (Refer to **Section 4.2**).

During construction, there will be a short term disruption to access across the ROW for the movement of vehicles and cattle. However, suitable alternative access for vehicles and cattle movement will be provided in consultation with the landholder.

During operation, land within the pipeline easement can continue to be used for its existing use, although restrictions will be placed on building directly over the easement (Refer to **Section 4.2**). Access to the proposed pipeline will also be required for maintenance inspections during operation. This will be provided along the length of the pipeline easement which will be accessed where the pipeline crosses existing roads.

Arrow has commenced consultation and notification of landholders directly affected by the proposed pipeline route and compensation will be paid to directly affected landholders in accordance with relevant legislation. Ongoing communication and consultation with landholders about construction activities, land access protocols and environmental management measures will help to reduce uncertainty for property owners about the use of land and help to ensure that construction of the pipeline minimises impacts on farming activities and operations. Consultation and communication with property owners during operation will also help to minimise potential property impacts associated with access by maintenance vehicles.

Consultation with property owners undertaken by Arrow identified a number of concerns of property owners about potential property impacts and disruption to existing farming operations from the proposed pipeline‘s construction and operation. These included impacts resulting from the potential spread of weeds between properties and land access issues such as the number of people accessing the property and potential for gates to be left open or fences damaged. The implementation of appropriate management and mitigation measures and land access protocols identified in the EMP (refer to **Chapter 5** of the EIS) will minimise potential impacts on property and farming operations during the construction and operation of the proposed pipeline.

Concerns were also raised by property owners about potential impact on property values and potential for loss of income due to the construction of the proposed pipeline. Given the short term nature of the project and its impacts on properties, the project is not likely to change property values or marketability of properties in areas near the project.

4.10.2.2. Population and demography

The project is expected to require a peak workforce of approximately 693 people for about a 15 month period during the construction phase. Workers would generally be accommodated in temporary workers' accommodation camps located along the pipeline route.

The influx of non-resident workers during the construction phase may result in small temporary changes to population and demography in those areas in which the temporary workers' accommodation camps are located. For example, given the range of employment opportunities offered by the project, it is expected that the majority of construction workers would be male and that many of these would be a younger working age (i.e. mid-20s to mid-40s). This is generally consistent with the existing demographic profile of the project area. The distribution of workers at the temporary workers' accommodation camps, which will be located progressively along the proposed pipeline route, would minimise potential impacts on population and demography at any one locality and overall, potential impacts are expected to be minor.

Potential impacts of the project on demand for community services and facilities are discussed in **Section 4.10.2.8** and **Section 4.11.2**.

4.10.2.3. Housing and accommodation

During construction, workers will be accommodated in temporary workers' accommodation camps. These will be located progressively along the proposed pipeline route with the location anticipated to be in the vicinity of Bajool, Foresthome, Hillcrest, Daunia and Red Hill.

The exact location of the temporary workers' accommodation camps will be determined during the detailed planning phase of the project and would consider the following aspects:

- Access: the temporary workers' accommodation camp will require all weather road access (for transport, food and water supplied, personnel access/egress etc).
- Proximity to the ROW: the temporary workers' accommodation camp will need to be located close to the ROW.
- Proximity to flood prone areas: the temporary workers' accommodation camp will need to be located outside of flood prone areas.
- Proximity to habitation: the temporary workers' accommodation camps will be located a minimum of 3 km from residences.

Each temporary workers‘ accommodation camp will be provided with a range of services and facilities to cater for the day-to-day needs for workers, including sleeping areas, showers and toilets, laundry, rest area, kitchen/ dining areas and limited recreation facilities. Protocols will also be established for each temporary workers‘ accommodation camp around worker behaviour and conduct. The provision of on-site services and implementation of worker protocols, along with the location of the temporary workers‘ accommodation camps away from towns and residential uses will minimise potential impacts associated with demand for community services and facilities in the project area and local amenity.

Specialist contractors would also be required to undertake a range of specialist activities such as HDD. These will generally involve about six to twelve people for short periods (i.e. about one to two weeks), although multiple teams could be working at locations along the proposed pipeline route at any one time. It is expected that these people would be accommodated in the temporary workers‘ accommodation camps. However, in some instances, some people may be required to be accommodated in short term or tourist accommodation. Given the small number of workers and the relatively short duration of the proposed activities, this is not expected to impact on the availability of short term accommodation in the project area.

The use of temporary workers‘ accommodation camps and short term accommodation (where required) would minimise demand for housing and accommodation in the project area and avoid impacts such increased housing costs. The use of temporary workers‘ accommodation camps and a FIFO workforce will not impact on housing prices or rental prices in the existing townships.

Impacts associated with the dislocation of workers from their families during the construction period are discussed in **Section 4.10.2.10**. These would be managed by the Principal Construction Contractor through ongoing communication and consultation with employees and the provision of good communication facilities within the temporary workers‘ accommodation camps (such as phone and internet).

4.10.2.4. Employment and training

The project is anticipated to directly employ 738 people over the life of the project, including construction, operation and decommissioning. Refer to **Section 3.3.2** for workforce profiles.

Skills shortages

Some locations in the project area currently experience relatively low levels of unemployment and a shortage of some skills. Increased demand for local workers during construction, either directly from the project or in local businesses that support construction activities, may impact on existing skills shortages in some industries as skilled and semi skilled workers seek employment on the project. This may potentially disadvantage local businesses and affect service provision for communities within the project area, either increasing the cost of access to services or the ability to provide these services. However, as the majority of employees will be FIFO workers the impact is likely to be minimal.

Training opportunities

The level of benefit for local communities from local employment would be dependent on access to appropriate skills and employment programs and the expected minimal use of local workers. The Principal Contractor will programme timely training and qualification for all workers where relevant to meet the needs of skills development for all phases of the project.

4.10.2.5. Local business and industry

The project would provide opportunities for local and regional businesses through demand for goods and services during construction, such as:

- Catering/ food services;
- Transportation;
- Sub-contract construction skills (including fuel supply, electrical, plumbing, fencing, etc); and
- Accommodation services.

This is likely to create indirect employment opportunities which would have positive benefits for local residents, including increased workforce participation and income levels.

The impacts of the project in isolation will be exacerbated when considered in the context of the broad range of major projects currently being undertaken or planned in the region. There are currently more than 40 mines operating or planned in the project area as well as 32 future planned projects. Should the construction of these projects coincide with the construction phase of the project, the cumulative impact on the local economy will be increased. The concurrent construction of these projects will put pressure on already scarce resources in the region such as skilled workers, accommodation, health services and transport services, and may result in a situation where there is insufficient capacity in the local economy to effectively meet the demands of each project, further increasing the need for sourcing of employees outside of the project area. In turn, this competition for resources may also impact the costs of project supply.

4.10.2.6. Economic impacts of the project

Specifically, the project is expected to provide a number of economic benefits to the project area as well as Queensland and Australia (Refer to **Section 4.12** and **Appendix A4.1**, **Volume 3**) including:

- Contribution to output;
- Contribution to household income;
- Contribution to employment; and
- An indirect contribution to energy self sufficiency and security of supply, and the continued prosperity of the Australian economy.

While some economic risks have been identified in the project area, they are generally low, and cumulative impacts associated with significant projects in the project area are negligible.

4.10.2.7. Transport and access

During construction, the project will require haulage of materials and equipment to various locations across the project area as well as transport of workers between the temporary workers' accommodation camps and the work areas. The primary transport route for equipment will be via the ROW, minimising the need for travel on local roads. However, some haulage activities (i.e. delivery of the pipe) will be required to occur on local roads. Transport of construction workers from the temporary workers' accommodation camps will be primarily via local roads to the ROW.

The project Traffic Impact Assessment (**Appendix A4.5**, **Volume 3**) identified that there will be a temporary increase in traffic on the road network throughout construction but any associated traffic delays to the community are deemed to be within acceptable timeframes. It is expected that these impacts will be satisfactorily managed through the implementation of a TMP. This will include early and ongoing communication with local communities about haulage routes and potential changes in road conditions. It is also expected that potential impacts on the operation of school bus routes from haulage activities will be negligible.

During operation of the project, traffic impacts will be negligible.

4.10.2.8. Community services and social infrastructure

The project does not directly impact on existing community services or social infrastructure in the project area.

The provision of on-site services such as recreational facilities, sleeping areas, showers and toilets, laundry, rest areas, kitchen/dining areas and first aid facilities with an on-site nurse or paramedic will minimise the need for workers to access community services and facilities, including local health services in local towns. However, in very limited cases, some workers may be required to access health and medical services in nearby towns, such as in the event of an emergency or for diagnosis and/or prescriptions. Overall, given that the likely demand for external health and medical services is expected to be on a rare occasion and for a relatively short period only, this is not expected to impact on the availability of health and medical services across the project area as a whole. However, some localities in the project area have limited health services and regionally, some health services are known to be severely constrained. Where possible, avoiding the use of services in these towns would mitigate potential impacts on these services.

The attraction and retention of health and social services employees has also constrained services growth in the region. This is largely due to the high housing prices and cost of living associated with some localities along the proposed pipeline route.

4.10.2.9. Community values and amenity

This section outlines potential impacts on community values, local amenity and community cohesion. Amenity plays a large part in determining community liveability and well-being, and is a term given to the attributes and appeal of a place. This can be negatively affected by loss of access to facilities and locations of significance or places where people gather for social interaction.

Several recreation facilities and other social infrastructure, such as sports grounds, racecourses, schools and churches, are located within the project area. Noise nuisance from construction activities, construction traffic, and temporary workers‘ accommodation camps may potentially impact on the amenity and use of a small number of residents living close to the project construction works. However, these impacts are anticipated to be minor as they will be short term and temporary in nature as construction moves along the proposed pipeline route and temporary workers‘ accommodation camps will be remote from sensitive receptors.

Environmental management strategies will be implemented, together with a TMP throughout the project will be constructed in a manner that causes no detriment to the long term ambient air and noise quality of the local area. Ongoing stakeholder consultation, community information and education during construction will also assist in mitigating potential impacts. Stakeholder engagement will take place with the residents in proximity to potentially noisy activities in advance of any works taking place.

4.10.2.10. Project workforce

During construction, employees will commute from their permanent homes, either interstate or from other Queensland regions, and reside in the temporary workers‘ accommodation camps for their shift roster. While this arrangement helps to mitigate potential social impacts locally such as those relating to employment, housing and accommodation, and demand for community services and facilities, the proposed FIFO working arrangements may impact on some workers and their families in the following ways:

- Isolation from family and friends and existing social and support networks in other areas;
- Increased stress for workers and their families due to changes to family functioning where employees are away from their permanent homes for extended periods during the roster; and
- Stress related to shift work and commuting potentially impacting on the general health and well-being of affected workers and their families.

These impacts would be managed by the contractors through ongoing communication and consultation with employees, and the implementation of transition programmes, that include access to specialist services such as GPs, and counselling/family support. This will be included in the Construction Safety Management Plan (CSMP) described in **Section 4.11.2.2**.

The provision of good communication services within the temporary workers' accommodation camps, including phone and internet access, would also assist workers in maintaining contact with their families during their shift roster and reduce feelings of isolation for some workers.

4.10.2.11. Cumulative impacts

In 2008, the Queensland government released the Sustainable Resource Communities Policy in response to the need to manage growth in the resource development areas that includes the Bowen Basin. The resource boom has led to a range of impacts on the local communities in the Bowen Basin related to the cumulative effect of a wide range of major projects. These impacts include:

- Increased rental and housing costs;
- Increased working age population, primarily male causing an imbalance in the population mix;
- Strained local government and non-government services and recreational facilities;
- Skills shortages that are driving the increased use of FIFO workforce;
- Increased wages in the resource sector that cannot be matched by other industries;
- Strain on local infrastructure such as roads and transport; and
- Consultation fatigue.

The use of a FIFO workforce located in temporary workers' accommodation camps for the duration of the construction phase would assist in managing potential demand on housing and community services in the project area. However, it is expected that small specialised project teams (e.g. HDD crews) may be housed in a motel in the local community.

While the project impacts will be minor and temporary it will contribute in a small way to the cumulative impacts that stem from the resource boom. It is not possible to ascertain the degree of that impact but it will partially contributes to, a short term temporary increase in traffic through the transportation of line pipe and fresh produce and temporary short term increase of some local services for fresh produce.

4.10.3. SUMMARY

Accommodation for the construction workers will be in temporary workers‘ accommodation camps near the ROW. In addition, there may be requirements for small specialist work crews (poor boy crews) which may require accommodation for a few weeks in a local motel. Recreational facilities will be provided in the temporary workers‘ accommodation camps to avoid impacts on facilities in existing townships. Temporary workers‘ accommodation camps will also be provided with a range of services and facilities to cater for the day-to-day needs of workers, including sleeping areas, showers and toilets, laundry, rest and recreation area, kitchen/dining areas and first aid facilities.

Some local workers will be required for unskilled jobs such as fuel suppliers and fencing contractors. This provides an opportunity to populations in areas where the unemployment is high, for youth and Indigenous people. Although the work is short term, the skills acquired will assist in obtaining future employment. The use of temporary workers‘ accommodation camps and a FIFO workforce will not impact on housing prices or rental prices in the existing townships. Employment opportunities for Indigenous people with suitable training will be explored for a number of supporting roles, including rehabilitation.

Demand on local hospital based services are not anticipated as the temporary workers‘ accommodation camps have a nurse and/or paramedic who can attend most cases. In the instance of major trauma cases workers will be transported to a major regional health facility for specialist care. In rare instances, there may be a minor short term impact on GP services in the projects area when a paramedic is unable to treat a worker and the case is not suitable for transportation to a major regional hospital. Identification of GP services that have the capacity will be provided to workers to ensure GPs are still able to service the local community.

Arrow has contacted and will continue to consult with all landholders affected by the proposed pipeline. Mitigation measures to address environmental and social issues are presented in the SIMP (refer to the *Social Impact Assessment* in **Appendix A4.2**, **Volume 3)** and EMP (refer to **Chapter 5**). A Social Consultation Plan (SCP) (refer to the *Social Impact Assessment* in **Appendix A4.2**, **Volume 3**) will ensure ongoing community and government consultation, and any social impacts will be mitigated and managed in accordance with these plans. This will ensure that any social and community impacts on existing communities as a result of the project are negligible.

Social impacts associated with the project have been assessed for all stages of the project including the construction, operation and decommissioning. Overall, the project is expected to provide minor benefits to local and regional communities through direct and indirect employment opportunities. However, the project is likely to have some minor impacts for communities closest to the proposed pipeline route, due to temporary disruption to land uses during construction and changes to local traffic and access.

While some social impacts have been identified in the project area, they are generally minor and cumulative impacts associated with significant projects in the project area are negligible.

The project commitments against each of the potential impacts are discussed in **Section 4.10.2** and are provided in **Table 4-93**.

Table 4-93: Project commitments

Issue	Commitment
Stakeholder consultation	▪ Ongoing communication and consultation with landholders to reduce uncertainty for property owners about the use of the ROW and easement (including conversion of the ROW to an easement option) during construction and operation respectively.
Population and demography	▪ Provision of fully self-contained temporary workers' accommodation camps for FIFO workers with a range of services and facilities to cater for the day-today needs for workers, including sleeping areas, showers and toilets, laundry, rest and recreation area, kitchen/ dining areas and first aid facilities. ▪ Implementation of worker behaviour protocols throughout construction.
Community services and social infrastructure	▪ Provision of fully self-contained temporary workers' accommodation camps for FIFO workers with a range of services and facilities. ▪ The capacity of health services, in particular GP services, will be identified to minimise impact to local health services
Community values and amenity	▪ Location of temporary workers' accommodation camps away from residential dwellings in order to reduce the likelihood of disturbance. ▪ Implementation of a TMP to mitigate any traffic impacts.
Project workforce	▪ Provision of facilities for workers to contact family and friends. ▪ Provision of counselling and advice services for workers as required.

4.11. HEALTH AND SAFETY

This section identifies and describes the community-related health and safety values associated with the proposed pipeline route and assesses the potential community related impacts and mitigation measures resulting from the project.

The health and safety of the community will be given high priority during all phases of the project, from design to construction and operation and finally through to its eventual decommissioning.

Arrow Energy maintains an *Environmental, Health and Safety Management System* which provides a framework for continually improving the management system and management practices that minimise any adverse environmental, health and safety impacts arising from the project.

The main construction, commissioning and operational related hazards and risks associated with the project workforce are outlined in **Section 4.13**.

Legislation, policies and guidelines

The assessment of health and safety associated with the project is based on relevant legislation, policies and guidelines as outlined in **Table 4-94**.

Table 4-94: Legislation, policies and guidelines

Legislation, policies and guidelines	Relevance
Building Act 1975 and *Building Fire and Safety Regulation 1991*	▪ Regulates the safe design and operation of all buildings so as not to endanger persons, property or the environment.
Explosives Act 1999 and *Explosives Regulation 2003*	▪ Regulates the safe utilisation, storage, handling and disposal of explosives during all stages of the project so as not to endanger persons, property or the environment. ▪ If explosives are required for the project, such as for blasting along in-field pipeline routes or down in wells, a licence or approval under this Act will be required for the purchase, transportation and use of explosives.
Fire and Rescue Service Act 1990 and *Fire and Rescue Service Regulation 2001*	▪ Establishes effective relationships and implementation of the Queensland Fire and Rescue Service (QFRS) and provides for the prevention of and response to fires and certain other incidents endangering persons, property or the environment and for related purposes.
Health Act 1937, *Health Regulations 1996* and *Health (Drugs and Poisons) Regulations 1996*	▪ Ensures a safe and healthy environment so as not to endanger persons, property or the environment.

Legislation, policies and guidelines	Relevance
Petroleum and Gas (Production and Safety) Act 2004 (P&G Act)	▪ Provides for the development of a safe, efficient and viable petroleum and fuel gas industry in Queensland. Refer **Section 1.5.1.2**
Radiation Safety Act 1999 and *Radiation Safety Regulation 1999*	▪ Regulates safe utilisation, storage, handling and disposal of radioactive materials so as not to endanger persons, property or the environment. ▪ If radioactive sources are required/employed in weld testing, Arrow will ensure radioactive sources have the required licence and an approved radiation safety and protection plan, detailing radiation protection measures.
Transport Operations (Road Use Management) Act 1995 and associated regulations for dangerous goods and other relevant aspects	▪ Establishes a scheme to allow management of traffic to enhance safety and transport efficiency.
Workplace Health and Safety Act 1995 and *Workplace Health and Safety Regulation 2008*	▪ Regulates the workplace health and safety of any person is not affected by the conduct of the business operations and to provide a healthy and safe work environment.

Relevant national and international standards

The key standard that applies to health and safety for the project includes Australian Standard (AS) 2885: *Pipelines – Gas and Liquid Petroleum* (AS 2885). AS 2885 is the Australian Standard covering gas and liquid petroleum pipelines. This is the primary Australian Standard that will be used as a basis for the design, construction and operation of the project‘s pipeline system. Part 1 of this Standard, Australian Standard 2885.1-2007: *Pipelines – Gas and Liquid Petroleum – Design and Construction* (AS 2885.1) defines the requirements for the design and construction of gas pipelines.

Key requirements of AS 2885 limit the consequences and likelihood of off-site impacts and these requirements will be implemented as part of the project, including:

- Development of a ‗fracture control plan‘ to ensure selection of pipeline material which is resistant to brittle or ductile fracture;
- Provision of a level of resistance to penetration of the pipeline to reduce the likelihood of penetration and significantly reduce the likelihood of a full bore rupture;
- Prevention of rupture in ‗high consequence‘ class locations; and
- Maximum tolerable energy release rates. This limits the radiated heat flux generated from a fire.

The following provides an indicative list of other major health and safety standards that may be applicable to the project:

- AS 1170.4:2007: Structural design actions - Earthquake actions in Australia;
- AS 1210:1997: Pressure vessels;
- AS 1768:2007: Lightning protection;
- AS 1885.1:1990: Workplace injury and disease recording standard in the workplace;
- AS 1940-2004: The storage and handling of flammable and combustible liquids;
- AS 2865:1995: Safe Working in a Confined Space (NOHSC:1009(1994)) ;
- AS 2958: Earth-moving machinery – Safety;
- AS 3780-2008: The storage and handling of corrosive substances;
- AS 3814-2009: Industrial and commercial gas-fired appliances;
- AS 4024: Safety of machinery;
- AS ISO 31000:2009: Risk management, principles and guidelines;
- AS 4801:2001: Occupational health and safety management systems - Specification with guidance for use;
- AS 60079.10.1:2009: Explosive atmospheres - Classification of areas - Explosive gas; atmospheres (IEC 60079-10-1, Ed.1.0 (2008) MOD);
- AS IEC61511:2004: Functional Safety – Safety instrumented systems for the process industry sector;
- National Standard for Construction Work [NOHSC: 1016 (2005)];
- National Standard for Manual Tasks (2007);
- National Standard for Occupational Noise [NOHSC: 1007 (2000)];
- National Standard for Plant [NOHSC: 1010 (1994)];
- Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC: 1003 (1995)];
- Australian Code for the Transport of Dangerous Goods by Road and Rail, 7th Edition;

- Australian Code for the Transport of Explosives by Road and Rail, 3rd Edition;
- National Code of Practice for the Control of Workplace Hazardous Substances [NOHSC: 2007 (1994)];
- National Code Of Practice for Induction for Construction Work, May 2007;
- National Code of Practice for the Prevention of Falls in General Construction, April 2008;
- The National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007);
- National Code of Practice for the Prevention of Occupational Overuse Syndrome [NOHSC:2013(1994)];
- Hazardous Substances Code of Practice: 2003;
- Mobile Crane Code of Practice 2006;
- Plant Code of Practice 2005;
- Risk Management Code of Practice 2007; and
- Traffic Management for Construction or Maintenance Work Code of Practice 2008.

Health, Safety and Environment (HSE) Management Standards

The project will be developed to be consistent with the following standards for Health, Safety and Environment (HSE) Management Systems:

- AS ISO 14001:2004(b): Environmental Management Systems (EMS) – Requirements with guidance for use;
- AS ISO 14004:2004(c): EMS – General guidelines on principles, systems and supporting techniques;
- AS 4801:2001 Occupational health and safety management systems – Specification with guidance for use; and
- AS 4804:2001(a): Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques.

Methodology

The assessment of the community related health and safety impacts in relation to the proposed pipeline route and the project area is based on:

- A desktop review of existing spatial information (GIS) within a 1 km buffer either side of the proposed pipeline route;
- Confirmation of location of closest human residences to the proposed pipeline route by Arrow field officers;
- A review of information on the Queensland Government Health website: http://www.health.qld.gov.au/wwwprofiles/default.asp (2011) to determine the health districts within the project area; and

A 1 km buffer either side of the proposed pipeline route was adopted to identify community health and safety values, including places of human residences, places of work, recreational features and aged care facilities. This conservative buffer area was adopted to identify values which may potentially be impacted by the construction, commissioning and operational activities along the ROW. Due to their distance from the ROW and the nature of the project in terms of health and safety impacts, values outside of the 1 km are not predicted to be impacted.

Health services, e.g. hospitals, ambulance services and General Practitioners (GPs) were identified within the wider project area, as defined in the *Social Impact Assessment* (**Appendix A4.2**, **Volume 3**), due to the location of these services and the distance which may need to be travelled in the event of an incident or emergency.

The health and safety environment, impacts and mitigation measures associated with the temporary workers' accommodation camps have not been discussed within this chapter. Any impacts associated with the temporary workers' accommodation camps will be addressed in separate IDAS applications pursuant to the SP Act.

4.11.1. DESCRIPTION OF VALUES

This section describes the existing community values for community health and safety and quality of life within the project area and identifies potential impacts from the pipeline construction, commissioning and operation.

The community health and safety values addressed in this section include:

- Human residences;
- Places of work and schools;
- Recreational features;

- Health services, including hospitals and aged care facilities; and
- Water bodies used for potable supply in public or private use.

Human residences

Main centres and smaller townships located within the vicinity of the proposed pipeline route (from AB0 to AB477) include:

- Glenden;
- Nebo;
- Moranbah;
- Dysart;
- Middlemount;
- Rockampton;
- Marlborough;
- Bouldercombe;
- Duaringa;
- Bajool;
- Raglan;
- Gracemere;
- Mount Larcom; and
- Calliope.

Less than 100 residential dwellings have been identified within a 1 km buffer either side of the proposed pipeline route as identified in **Section 4.2**. Only two residential premises are located within 100m of the pipeline, with the closest residential dwelling being located approximately 80 m from the proposed pipeline route at AB395.

Places of work and schools

The following community health and safety related values in relation to places of work and schools were identified within a 1 km buffer (either side) of the proposed pipeline route near AB468.

- Mount Larcom Ambulance Station;
- Mount Larcom Police Station;
- Mount Larcom Library; and
- Mount Larcom State School.

Recreational features

No recreational features were identified within 1 km either side of the proposed pipeline route. This included a search of community related recreational features such as sports fields/centres and parks.

Hospitals, health services and aged care facilities

Hospitals and healthcare facilities within the project area are identified in the *Social Impacts Assessment* (**Appendix A4.2**, **Volume 3**).

The proposed pipeline route crosses the following Health Service Districts (HSD):

- Mackay HSD; and
- Central Queensland HSD.

There are seven hospitals and 12 ambulance stations in the Mackay and Central Queensland HSDs. The capacity of health services in the HSDs was not available at the time of writing the EIS.

Other than the Mount Larcom Ambulance station, there are no health services or aged care facilities within a 1 km buffer either side of the proposed pipeline route.

Within each temporary workers' accommodation camp there will also be an on-site nurse or paramedic and a medical facility.

Potable water supply in public or private use

The individual residences identified within a 1 km buffer either side of the proposed pipeline route are likely to have a private potable water supply in the form of dams, rainwater and roof collection tanks.

A *Water Availability Study* provided in **Appendix A4.9**, **Volume 3**, identifies potable water supplies within the project area to be utilised by the temporary workers‘ accommodation camps. These include local reticulated water supplies in the towns of Moranhbah, Middlemount, Marlborough, and Rockhampton. A summary of this Study can be reviewed in **Section 4.5**.

4.11.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

Residences, places of work, schools, recreational features and aged care facilities

The health and safety community-related impacts and mitigation measures in relation to noise, dust and odour are described in detail in **Section 4.6** and **Section 4.7**.

No health and safety community-related impacts to residences, places of work, schools, recreational features or aged care facilities (identified in **Section 4.11.1**) are predicted. This is due to the distance of these features from the project site. Temporary workers‘ accommodation camps have also been specifically located away from these locations.

Measures will be put in place to restrict public access to construction activities. There will be an ongoing program of community information and education during construction and signs will be installed where the ROW intersects the public road network, and to provide contact information in the event of an incident.

During the operational phase, valve stations and other above-ground installations along the proposed pipeline route will be fenced and appropriate signs erected. Regular inspections will be made along the ROW to detect any third party activities that may interfere with the pipeline or create a public risk.

Health services

It is predicted that there will be limited impacts to the health services (hospitals) identified in **Section 4.11.1**.

In the event of an accident or incident, in the first instance the project construction workforce will utilise the first aid room or medical facility established at the nearest temporary workers‘ accommodation camp. An on-site nurse and/or paramedic will also be located at each camp to treat any illness or injury. The Queensland Ambulance Service will be consulted to provide pre-hospital care and transport if necessary.

Dependent on the nature of any illness or injury and if necessary, workers will be airlifted or transferred to the nearest hospital, as identified in **Section 4.11.1**. It is expected that these hospitals will have capacity to treat the worker whilst continuing to treat the community.

In rare instances, there may be a minor short term impact on GP services in the project area when a paramedic is unable to treat a worker and the case is not suitable for transportation to a major regional hospital. Identification of GP services that have the capacity will be provided to workers to ensure GPs are still able to service the local community.

The identified HSDs, hospitals and ambulance service will be advised of the project timetable and made aware of the possible need for their services during the construction phase. This will be updated prior to the construction phase commencing and as work progresses. These contact details will be used by the paramedics if required, and any potential health and safety impacts will be managed through appropriate health and safety policies that will form part of the Construction Safety Management Plan (CSMP) and EMP.

An Emergency Response Plan (ERP), including details of emergency evacuation procedures, will be prepared for all foreseeable emergency situations and incidents that could occur as a result of project construction and commissioning.

Potable water supply in public or private use

It is predicted that there will be no impacts to potable water supply to residences as any potential spillages/leakages from the project will be minimal and localised to the project area. Any accidental spills and leakages will also be cleaned immediately to avoid any impact. Further, appropriate mitigation measures will be implemented during the construction and commissioning phase of the project to ensure accidental spillages and leakages are prevented.

Extreme meteorological events

The hazards and risks and associated mitigation measures in relation to extreme meteorological events are addressed in **Section 4.13** of the EIS and the *Initial Pipeline Safety Management Study* in **Appendix A4.5**, **Volume 3**.

The community health and safety impacts associated with extreme meteorological events will be managed and monitored through the implementation of an ERP and CSMP. These Plans will outline management measures to ensure there are no releases of toxic materials during construction and commissioning of the project associated with extreme meteorological events.

Spreading of diseases, weeds and animal pests

Potential impacts associated with feral animals, pests and exotic animals are addressed in **Section 4.8**.

Management strategies will be developed to limit the spread of fauna pest species along the proposed pipeline route during the construction phase. The Health and Safety Officer/s will undertake regular toolbox talks and review construction work areas to remove and/or minimise any risks from exposure to wildlife hazards.

4.11.2.1. Arrow Energy's Environmental, Health and Safety Management System

Arrow Energy maintains an Environmental, Health and Safety Management System (EHSMS) which provides a framework for continually reviewing and improving the management system and management practices that minimise any adverse environmental, health or safety impacts arising from its activities, services or products.

Arrow Energy operates in compliance with Commonwealth, State and local government statutes and industry guidelines. It has also implemented an Integrated Health, Safety and Environmental Management System (HSEMS) to manage environmental issues linked to all its activities.

Arrow Energy‘s Environmental Policy states:

> ―*Arrow Energy's aim is to achieve a high standard of care for the natural environment in all of the activities in which we engage including gas exploration, development, production and decommissioning of gas supply service, planning, design of new infrastructure, management of existing infrastructure, the provision of technical services, and at all times, to minimise the impact of our activities on the environment*".

4.11.2.2. Construction Safety Management Plan

A CSMP will be prepared for the project and will include appropriate measures and policies to manage health and safety during construction to reduce the risks to the community‘s health and safety and quality of life values. The contractor will comply with the requirements of the CSMP and of the *Workplace Health and Safety Regulation 2008.*

The CSMP will comply with both the *Workplace Health and Safety Act 1995* and the *Petroleum and Gas (Production and Safety) Act 2004* and meet the requirements of current industry-wide management system principles and best practice including the *Safeguard for Petroleum and Gas – Safety and health management systems audit criteria*, and *Australian Standard 4804:1997 – Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques*.

The CSMP will provide high-level guidance and direction during construction and commissioning. Additional procedures and plans may be developed to supplement the CSMP and to provide specific day-to-day guidance as requirements change over the life of the project (e.g. moving from pre-construction to construction to commissioning and operation).

The CSMP will be an iterative document and will establish a formal, yet flexible, structure for the identification and management of health and safety issues.

4.11.2.3. Initial Pipeline Safety Management Study

An *Initial Pipeline Safety Management Study* (**Appendix A4.6**, **Volume 3**) has been produced in accordance with AS 2885.1, to maintain the integrity of the proposed pipeline in all situations (refer to **Section 4.13**). A more comprehensive study will be undertaken during the detailed design phase of the project. This will identify the variations and types of locations through which the proposed pipeline route will pass and the potential threats to and from the pipeline in each location. The study will also ensure that all credible threats are evaluated and properly managed during pipeline operation.

The future detailed safety management study shall determine exact physical and procedural measures, assess whether these measures eliminate the threat, assign consequences and likelihood values to non-eliminated threats, determine the risk ranking and assign appropriate risk treatment actions.

4.11.3. SUMMARY

No impacts to the community‘s health and safety as a result of the project are predicted due to the remote location of the proposed pipeline route, its distance from residences, places of work, schools, recreational features and aged care facilities, and the pipeline design.

To manage day-to-day medical treatment requirements, a first aid facility with an on-site nurse or paramedic will be provided at the temporary workers‘ accommodation camps. Agreements will be established with local health districts for nurses or medical professionals to visit camps if required. Hospitals, health care and GP services will be notified as the project progresses in the event that their services will be required. The procedures for emergency evacuation will also be outlined in an ERP.

Potential impacts associated with extreme meteorological events and any associated release of toxic materials will be mitigated through the implementation of management measures outlined in the ERM, the CSMP and the EMP.

No impacts to potable water supply as a result of accidental spillages/leakages during construction or operation are predicted due to the localised nature of any spills/leakages and the implementation of mitigation measures outlined in the EMP.

The health and safety commitments relating to the community‘s health and safety values as identified in the TOR are summarised in **Table 4-95**.

Table 4-95: Commitments for health and safety

Issue	Commitment
Existing health care services.	▪ Any potential health and safety impacts will be managed through appropriate health and safety policies as part of the CSMP. ▪ Health and Safety Officers will be present on the construction site. ▪ A nurse and/or paramedic will be present at temporary workers' accommodation camps. ▪ A first aid facility will be set up at each temporary workers' accommodation camp. ▪ An updated list of health services available along the pipeline route, including contact details, will be compiled. ▪ Local health authorities will be advised of the project timetable and made aware of the possible need for their services during the construction phase. The authorities will be updated as the project progresses down the pipeline route. ▪ Any potential health and safety impacts will be managed through appropriate safety and health policies that will be part of the CSMP. ▪ Employees will be warned about the possibility of wildlife hazards during induction.

4.12. ECONOMY

This section describes the economy of the project area and identifies economic impacts, benefits and risks. An *Economic Assessment* is provided in **Appendix A4.1**, **Volume 3** of the EIS.

The purpose of the *Economic Assessment* is to provide information on the potential economic impacts of the project at regional, state and national levels. It also identifies strategies for capitalising on economic benefits while at the same time mitigating any possible negative impacts.

Legislation, policies and guidelines

The assessment of the economic impacts associated with the project is based on applicable guidelines as outlined in **Table 4-96**.

Table 4-96: Legislation, policies and guidelines for economy

Legislation, policies and guidelines	Relevance
Information Paper: Australian National Accounts: Introduction to Input-Output Multipliers, Australian Bureau of Statistics (ABS) (1995)	▪ Calculation of Input-Output (IO) multipliers from ABS IO tables.

Methodology

The assessment of economic impacts in relation to the proposed pipeline route and the project area has been based on:

- A definition of the project area;
- A description of the local and regional economies;
- A review of the project background and regional developments;
- An estimation of the direct and flow-on economic effects of the project;
- A description of the impact on future local and regional economic development; and
- A description of the measures to enhance or mitigate impacts to local and regional populations.

The project area has been defined by identifying the potentially impacted local and regional economies along the proposed pipeline route.

Key assumptions

Key assumptions for the economic modelling of output, employment and income impacts include:

- Economic impacts for all stages of the project are assessed through derivation of multipliers utilising Input-Output (IO) methodology from the ABS and IO Tables (2006-07) and national accounts. The multipliers are designed to predict the total impact in all industries in an economy from changes in the demand for output in any one industry;
- Expenditure which is known to be imported is removed from the inclusion of direct impacts, therefore economic impacts associated with imports (such as supported employment at Australian ports and airports required for the receipt of imports into the national economy) are excluded from the analysis. For indirect impacts, a ‗direct allocation of imports' method is used.
- National multipliers are assumed as reflective of regional impacts and may not necessarily reflect the structure of regional economies/industries. Regional multipliers have not been used as they are significantly outdated compared to national multipliers;
- Assumptions surrounding project area allocation of expenditure are outlined where relevant in the report; and

- Estimates derived from the economic model are reflective of the employment that could be supported in a static economic environment and based on preliminary expenditure estimates;

Other assumptions are highlighted in **Section 4.12** and in the *Economic Assessment* (**Appendix A4.1**, **Volume 3**).

4.12.1. DESCRIPTION OF POTENTIALLY AFFECTED ECONOMIES

The proposed pipeline route falls within the Mackay and Fitzroy regions as follows:

- Whitsunday Regional Council (Mackay region);
- Isaac Regional Council (Mackay region);
- Rockhampton Regional Council (Fitzroy region), and
- Gladstone Regional Council (Fitzroy region).

The potential economic impacts will be partially distributed through these areas, but will also have an effect on the greater Queensland and national economies. An economic baseline provides the context for estimated impacts, describing initial employment and industrial structure and the populations that will be directly affected by the project and influence the overall impact on Queensland and Australia.

4.12.1.1. Regional infrastructure and development

A review of current infrastructure in the project area includes transport, energy, water supply and storage, stormwater drainage, sewerage, telecommunications and other infrastructure (**Chapter 3**). A review of significant projects in the project area has been provided in Section 2.4.3 of the *Economic Assessment* (**Appendix A4.1**, **Volume 3**).

These significant projects will support the Gladstone and Mackay ports and complement the overall economic vitality of the project area. It is expected therefore that the project will indirectly support ongoing port operations through cumulative benefits of line pipe imports for the project and LNG exports from the proposed Arrow LNG Plant on Curtis Island. Therefore an overview of the economic contribution from both ports is provided.

The Port of Gladstone is Queensland's largest multi-commodity port. As home to the world's fourth largest coal export terminal (GPC, 2011), it is an important contributor to the regional economy. The Port of Gladstone which includes the Gladstone Marina and surrounding parklands as well as the Port Alma Shipping Terminal is managed and operated by the Gladstone Port Corporation (GPC) and owned by the Queensland government. It handles over 30 product types which are exported to more than 30 countries, and currently directly employs over 600 people[9].

Major products types handled in the port include coal, alumina, aluminium and cement. The Port of Gladstone handles over 50 million tonnes of exported coal per annum, of which 75 percent is comprised of coking coal and the remaining 25 percent is thermal coal.

The Port of Mackay is Queensland‘s fourth busiest multi-commodity port in terms of cargo throughput. The Port of Mackay is owned by the Queensland government and is operated by the North Queensland Bulk Ports Corporation Limited[10]. It comprises four berths, catering for the export of sugar and sugar products, molasses and grain and the import of petroleum, handling a total of 175 ships in 2010-11.

4.12.1.2. Economic activity and trends in relevant indicators

Gross Regional Product

The Gross Regional Product (GRP) is the description of regional economic output and represents the total market value of goods and services produced within a region after subtracting costs of production – it is the regional equivalent of Gross Domestic Product (GDP) nationally and the Gross State Product (GSP) at State level as shown in **Table 4-97**.

Table 4-97: Gross State and Regional Product

Region	2000–01 ($m)	2005–06 ($m)	Average annual growth
Fitzroy	12,041	14,126	3.2%
Mackay	10,468	13,698	5.5%
Queensland	**145,629**	**183,983**	**4.8%**
Rest of Australia	**674,929**	**783,471**	**3.0%**

Source: OESR (2011), Experimental Estimates of Gross Regional Product

Industrial contribution

The industrial composition of GRP by Australian and New Zealand Standard Industrial Classification (ANZSIC) for both the Mackay and Fitzroy regions is presented in **Figure 4-22**, and shows that the economies in the project area are heavily focused on mining (55.8% and 39.3%), while the cultural and recreational services (0.3% and 0.4%) are the smallest part of the economies of the project area. The mining industry has also become the largest part of the Queensland economy, comprising 10.6% of the economy during the same time period.

[9] In 1999-2000 the Port was estimated to generate 1,758 jobs and $224 million in output (Bureau of Transport Economics, 2001).

[10] Formerly Mackay Ports Limited and Ports Corporation of Queensland Limited.

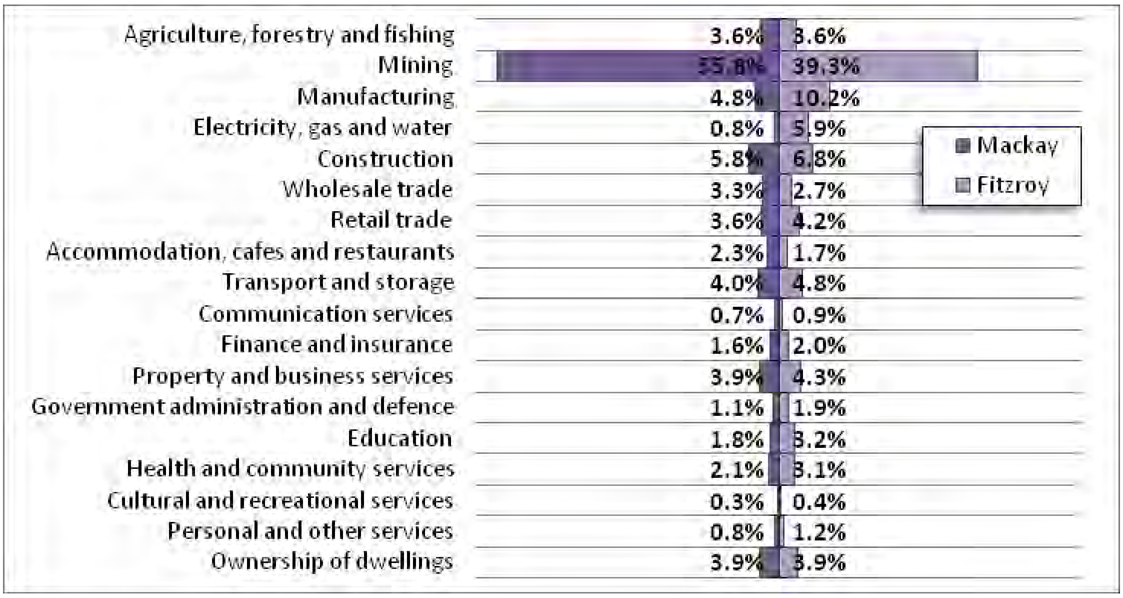


Figure 4-22: Industrial Composition of GRP, 2005-2006

Source: Office of Economic and Statistical Research, Experimental Estimates of Gross Regional Product

Employment

The employment by industry for the project area shows that while mining may be the driving total economic output, jobs are spread across industries as shown in **Figure 4-23**.

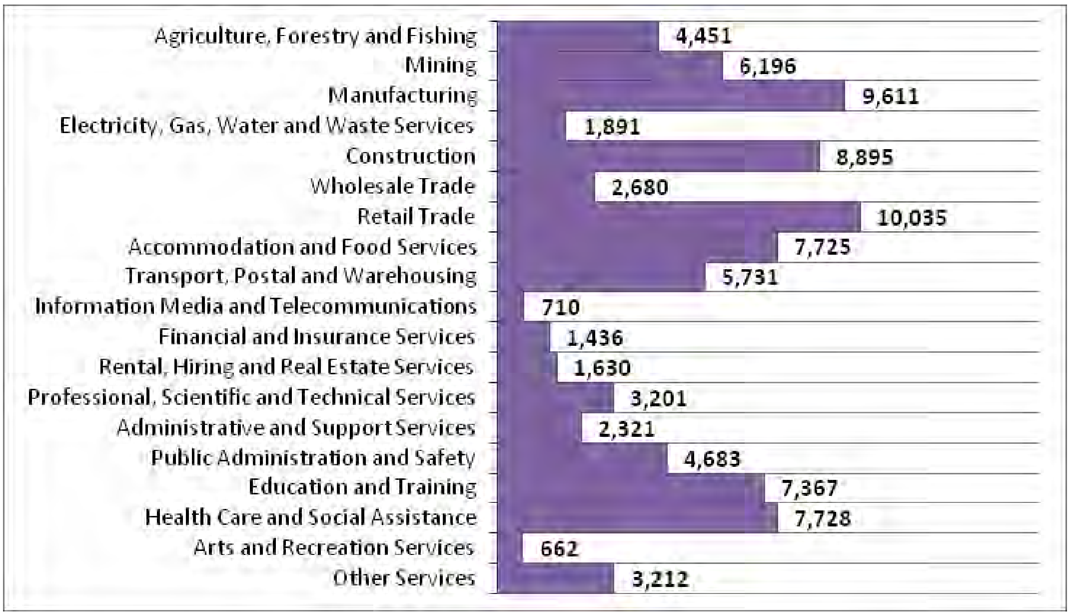


Figure 4-23: Project Area Regional Employment by Industry, 2006

Source: ABS 2006 Census of Population and Housing

Occupation

The labour force occupations are shown in **Table 4-98**. The workforce statistics show a high concentration of skilled labour with technicians and trade workers making up a large proportion of employment in the project area along with machinery operations and drivers and labourers – especially in the Isaac Regional Council where industry in mining intensive.

Table 4-98: Occupations, Project Area

Occupation	Whitsunday	Isaac	Rockhampton	Gladstone
Managers	14.5%	12.9%	10.5%	9.9%
Professionals	10.1%	9.9%	15.1%	12.3%
Technicians & trades workers	16.7%	20.1%	17.1%	21.9%
Community & personal service workers	9.0%	4.6%	9.6%	7.0%
Clerical & administrative workers	10.4%	8.3%	14.4%	11.8%
Sales workers	9.5%	5.2%	10.0%	8.4%
Machinery operators & drivers	9.8%	24.9%	8.3%	13.1%
Labourers	18.1%	12.3%	13.3%	13.6%

Source: ABS 2006 Census of Population and Housing

4.12.1.3. Industry significance

Key industries which are likely to be impacted by the project are identified as follows below:

- Mining;
- Agriculture;
- Construction;
- Manufacturing; and
- Gas and LNG.

The estimated economic impacts associated with historic and proposed gas pipeline projects, which may be used as a comparison to the impact assessment conducted for the project in are summarised in **Table 4-99** below.

Table 4-99: Comparison of Gas Pipeline Projects

Project	Proponent	Contribution to Employment	Contribution to Output	Contribution to Household Income
North Queensland Gas Pipeline	Enertrade	▪ Workforce of 84 FTEs for construction (direct) ▪ 40 – 81 FTEs from flow on impacts during construction	N/A	N/A
Queensland Hunter Gas Pipeline	Hunter Gas Pipeline Pty Ltd	▪ Workforce of 600 during construction (direct impact) ▪ Workforce of 25 initial operation (direct impact)	Direct Impact: $900 million	N/A
Arrow Surat Pipeline (formerly Surat-Gladstone Pipeline)	Arrow CSG (Australia) Pty Ltd (formerly Shell CSG (Australia) Pty Ltd)	▪ Workforce of 450 during construction (direct impact) ▪ Workforce of 15 during operation (direct impact) ▪ 6,200 FTEs including flow on impacts during construction ▪ 33 FTEs including flow on impacts per year of operation	▪ Direct Impact: $564 million ▪ Production Induced Impact: $453 million ▪ Consumption Induced Impact: $353 million	N/A
Gladstone LNG Project (impacts refer to the construction and operation of the CSG pipeline)	Santos Limited and Petroliam Nasional Berhad (PETRONAS) and others	▪ Workforce of 1,000 – 1,500 during construction (direct impact) ▪ Workforce of 8 per year for operation (direct impact)	N/A	N/A

Project	Proponent	Contribution to Employment	Contribution to Output	Contribution to Household Income
QCLNG Project ▪ **Gas field expansion** ▪ **Network of Gas pipelines** ▪ **LNG plant and export facility**	Queensland Gas Company Ltd, a wholly owned subsidiary of the BG Group	▪ 18,889 FTE employee years in Queensland during construction: 2010-2013 (including flow on impacts) ▪ 40,749 FTE employee years in Queensland during operation (including flow)	▪ Approximately $2.4 billion in value-added activity during construction ▪ Approximately $29.5 billion in value-added activity	$2.65 billion between 2010 and 2021 including flow on impacts
Australia Pacific LNG Project	Australia Pacific LNG (50:50 joint venture between Origin Energy and ConocoPhillips)	▪ Workforce of 805 for construction (direct impact) ▪ Workforce of 20 during operation (direct impact) ▪ 9,900 FTEs (including flow on impacts during construction	▪ $1.4 billion in value added during construction (including flow on impacts) ▪ $1.3 billion per year in GDP during operation	N/A

4.12.1.4. Opportunity cost

Opportunity costs of the project refer to the value of foregone opportunities for other economic activities undertaken in the future. Any potential disruption to agricultural productivity occurring during construction will be fully compensated at market value to the affected land owners. Therefore the opportunity cost of the project is zero.

4.12.1.5. Sterilisation

The pipeline route has been chosen so that it does not sterilise any of the states coal, mineral petroleum and natural gas/coal seam gas resources and state-significant resources.

4.12.2. STRATEGIC ALIGNMENT WITH GOVERNMENT POLICY

The following **Table 4-100** outlines the project alignment with key government initiatives.

Table 4-100: Key Government Policies

Key initiative	Alignment with the project
The Local Industry Policy – a fair go for local industry	
▪ Recognise that involving local industry in projects and capital asset acquisitions provides economic benefits to all parties and is crucial to the long term development of a strategic manufacturing and service industry capability that underpins a strong and diversified Queensland economy.	▪ Partially
▪ Ensure that Queensland and Australian suppliers are given a full, fair and reasonable opportunity to tender and participate in all stages of projects and acquisitions subject to this policy.	▪ Yes
▪ Use Australian Standards and codes in the formulation of specifications, tenders and the letting of contracts (except where it is unreasonable to do so).	▪ Yes
▪ Seek to maximise the level of goods and services, including design services, from local companies where they are competitive with respect to cost, quality and timeliness.	▪ Yes
▪ Seek to incorporate this policy into contracts entered into with third parties for the supply of goods and services.	▪ Yes
Rockhampton Regional Council Corporate Plan 2009-2013	
▪ A prosperous and self sustaining region. ▪ Effective infrastructure management. ▪ To be regarded as a financially strong council. ▪ Increased investment in the region, through the attraction of new and diverse industry and the creation of long term employment opportunities.	▪ Yes
▪ Protect and enhance the region's environmental values. ▪ Regional development that encourages and supports sustainable growth whilst protecting the environment for future generations. ▪ Active development and support of sustainability initiatives that both benefit the region and contribute to a wider global response to protecting our environment.	▪ Partially
Gladstone Region Economic Development Strategy	
▪ Continue to facilitate Large Scale Industrial Development Projects and Maximise Economic Potential of Gladstone's State Development Area and Port Assets.	▪ Yes
▪ Grow the Gladstone region's export capacity and facilitate export market development for the region's small to medium sized enterprises.	▪ Yes
▪ Facilitate local industry skill development and supply chain opportunities.	▪ Yes
▪ SME support, promotion and acknowledgement of its economic contribution.	▪ Yes
▪ Foster industry sector business clusters and networks.	▪ Yes
▪ Facilitate training and develop infrastructure to expand local construction workforce.	▪ Partially

Key initiative	Alignment with the project
Whitsunday Regional Council Corporate Plan 2009-2013: Tourism and Economic Development Strategies	
▪ To foster and support Economic, Tourism, Social and Cultural Development within the region.	▪ Yes
▪ To be a key player in economic growth within the region.	▪ Yes
▪ Developing community and stakeholder partnerships.	▪ Partially
▪ Improving the knowledge of public health standards and sustainable practices such as – mitigating impacts of industry, waste management, recycling and climate change.	▪ Yes
Isaac Regional Council Corporate Plan 2009-2014 "Our Economy"	
▪ Encourage balance to support sustainable economic futures.	▪ Yes
▪ Encouraging people to work, rest and play in the region.	▪ Partially
▪ Planning and advocating to improve key partnerships with governments, industry and business.	▪ Partially
Mackay, Isaac and Whitsunday Regional Plan, 2011 (Draft)	
▪ Sustainability and climate change – the region grows and changes in a sustainable manner, generating prosperity maintaining and enhancing quality of life, minimising the use of resources, providing high levels of environmental protection, reducing greenhouse gas emissions and increasing resilience to natural hazards, including the projected effects of climate change.	▪ Partially
▪ Natural resources – the region's natural resources and primary production lands are protected, rehabilitated and managed sustainably to ensure ongoing use, benefits and enjoyment for current and future generations.	▪ Partially
▪ Economic development – a diverse resilient and sustainable economy that supports and builds on existing economic strengths, provides opportunities for the establishment of new business and industry and supports diversification, continued growth and prosperity across the region over the long term.	▪ Yes

4.12.3. POTENTIAL IMPACTS AND MITIGATION MEASURES

This section assesses the economic impacts of the project on a regional, state and national level. The basis of the economic assessment is an IO model of the national economy in Australia. An IO model is a representation of the economy that shows the technological links between the various sectors in the economy. It shows both the sales and purchase of intermediate and final goods and services within an economy, demonstrating inflows in the form of raw materials and outflows in the form of exports. The model includes households, ensuring that it captures not only the economic activity of various industry sectors, but also the household expenditure within the economy which provides additional flow on effects in the form of supporting industries, services and jobs.

4.12.3.1. Queensland and project area distribution of impacts

The distribution of impacts to the project area depend on the regions from which inputs, such as materials and labour, are sourced for the project. Given Queensland's diverse resource supply, including an economy rich in petroleum and coal product manufacturing developments, as well as other significant industrial development, it is likely that a significant proportion of economic benefits would accrue to the project area. This is especially for construction, manufacturing and mining inputs.

Based on the lack of certainty surrounding expenditure in the project's area, the following assumptions have been made in **Table 4-101** based on input from Arrow's analysis of the project area's economy and studies undertaken for similar projects in the area. This excludes the line pipe which will be imported. Approximately 15 to 20% of materials and labour is predicted to come from the project area with the rest coming from greater Queensland and Australia.

Table 4-101: Distribution of project expenditure assumptions

Region/stage	Construction	Operation
Project area	20%	15%
Total Queensland	45%	45%
Total Australia	100%	100%

4.12.3.2. Economic linkages

The link between industry and economy, employment and income, as well as households and spending can be analysed by examination of IO multipliers based on the ABS IO tables. Using the 2007 data, the multipliers capture the direct, indirect and induced effects of economic stimulus in terms of income, output, and employment using the following multipliers:

- Output multipliers – the amount of output required from all industries to produce output to satisfy the demand for an extra dollar of output from an industry – this also includes the induced effects by spending of extra wages and salaries earned by households;
- Income multipliers – the additional wages, salaries and supplements earned from working to produce the extra output required; and
- Employment multipliers – measurement of the additional employment, in number of persons employed, generated by producing additional output in the economy.

4.12.3.3. Multiplier interpretation

The total economic impact identified by use of IO multipliers includes the direct effect of the initial increase in demand, the indirect (or ―flow-on") effects, and the induced effects.

The indirect effects result from the linkages between industries in the regional economy. An increase in the length of a pipeline for example, would also require additional steel from the manufacturing sector.

The induced, or consumption, effects result from the recycling of cash flows in the economy, or households (consumers) spending their wages. A new employee operating a transmission pipeline for example, may rent housing from a local owner or shop at the local grocery store and in doing so drive additional local employment and spending.

4.12.3.4. Economic impacts

The following section presents the results of the economic impact modelling across all stages of the project lifecycle. Benefits have been summarised by the project area, the total for Queensland, and the total of Australia.

The employment benefits in **Table 4-102** have been grouped by construction and annual operations and include direct employment from construction and operation, production induced employment from supporting industries and consumption induced employment impacts from consumer spending. Construction period employment impacts represent annual average FTE equivalent jobs over the construction period. Operational employment impacts are the annual average jobs created during the projected 40-year operational life of the pipeline with approximately 67% of employment coming from across Queensland.

Table 4-102: Project employment benefits*

Employment impacts	Construction**	Operations***	Total
Project area	1041	7	1048
Total Queensland	1846	19	1865
Total Australia	2952	28	2980

*Includes Direct, Indirect and Induced employment

**Average annual FTE employment during construction, 2016 through 2017

***Average annual employment that could be supported by the project

Income and output benefits are shown in **Table 4-103** and **Table 4-104** respectively and include all of the construction and operational effects over the 40-year life of the project. The project is estimated to generate a total of $627 million in personal income across nearly 3,000 jobs in Australia, with $128 million distributed to employment in the project area. The project itself is estimated to directly provide almost $35 million in personal income over the project life.

In total, the project will directly inject close to $891 million into the Australian economy and create a total impact across Australia of close to $2.9 billion. The majority of project benefits occur throughout the construction stage of the project, reflecting the magnitude of the capital investment and direct injection in the economy.

Table 4-103: Project income benefits

Income impacts	Direct („000,000)	Production induced („000,000)	Consumption induced („000,000)	Total („000,000)
Project Area	$34.6	$48.3	$45.8	$128.8
Total Queensland	$79.3	$110.6	$105.0	$294.8
Total Australia	**$148.2**	**$245.8**	**$233.2**	**$627.2**

Table 4-104: Project output benefits

Output impacts	Direct („000,000)	Production induced („000,000)	Consumption induced („000,000)	Total („000,000)
Project area	$173.9	$203.0	$225.9	$602.9
Total Queensland	$400.7	$465.3	$461.6	$1,327.6
Total Australia	**$890.6**	**$1,034.0**	**$973.0**	**$2,897.5**

The cumulative impact of the project in relation to other developments in the project area is expected to be negligible due to:

- The highly specialised nature of the construction workforce;
- The relatively small scale of construction labour required when compared to other projects;
- The short time frame of construction; and
- The relatively small impact of the project after construction.

Other effects such as those to wages, prices, consumption, property values and unemployment are shown in **Table 4-105**.

Table 4-105: Other effects

Impact	Project area level
Wages and salaries	Given the timing of construction and high likelihood of a FIFO workforce, the impact on wages and salaries in the project area is expected to be minimal at a project level.
Other prices	The timing of project construction is likely to contribute to stable demand as opposed to a significant shock to the economy and there is not expected to be significant upward pressure on other factor prices.
Consumption	At a regional level, the impact is not expected to be significant and will depend on where specific impacts occur and the extent to which income earned by workers during construction is consumed in localities along the proposed pipeline route.
Property values	During construction and commissioning, temporary workers' accommodation camps will be provided, with workers expected to be employed on a FIFO basis. Direct employment required for operation of the project is not significant. Therefore increase in demand for housing in the project area is limited and is not expected to have an impact on property values.
Unemployment	At a regional level, the project is not expected to impact heavily on unemployment, although any effect would be positive on the workforce.

4.12.3.5. Industrial linkages

The Heavy and Civil Engineering Construction (HCEC) industry accounts for the majority of direct construction related project expenditure and **Table 4-106** shows the main industries that provide material and support services, or direct inputs, into HCEC with the largest support coming from additional construction services. It also shows the primary industries that provide support to the water, pipeline and other transport industry during the annual operations. The industries in this table represent the primary supporting industries in which indirect impacts for employment, income and output are generated.

Table 4-106: Direct input requirements

Heavy and civil engineering and construction	Water, pipeline and other transport industry
Construction services	Transport support services and storage industry
Professional, scientific and technical services	Petroleum and coal product manufacturing
Building, cleaning, pest, administrative and other services	Professional, scientific and technical service
Structural metal product manufacturing	Finance
Wholesale trade	Wholesale trade

Other key support industries required to support the increase in final demand include:

- Basic non-ferrous metal manufacturing;
- Non-residential property operators and real estate services;
- Professional, scientific and technical services;

- Wholesale trade; and
- Auxiliary, finance and insurance service.

4.12.3.6. Contribution to energy markets

The project will enhance Australian energy self sufficiency and security of supply, transmitting gas for LNG production at the proposed Arrow LNG plant in Gladstone. LNG provides a relatively low carbon intensive energy source, and a means for diversification of energy sources to aid in satisfying long term energy supply for the Australian economy in line with depleting crude oil resources. As such, should Australia‘s energy supplies diminish in the near future, the project will have the opportunity to support the continued viability of energy supply in the Australian domestic market.

4.12.3.7. Government revenue

The project is expected to increase Federal government revenue through all stages of the project through increased tax receipts from household and private sector income, as well as through other government regulatory receipts. In economic terms, tax revenue represents a transfer of benefits from household or private sectors to the public sector, and does not reflect a change in economic condition relative to the aggregate benefits estimated from the economic impact assessment of the project. The distribution of tax income is difficult to determine, given that a significant level of expenditure and income would be taxed at a Federal level, and allocated through the national budget. However, the benefits to the Queensland government will likely be significant.

4.12.3.8. Balance of payments

During construction, the project will have a small affect on the Australian Balance of Payments (BOP) account and exchange rates through imports of materials. Therefore the project may decrease the BOP account in the short term.

The extent to which the project is financed through offshore capital markets may increase this effect. However, the size of the project in terms of capital outlay is small relative to GDP, and therefore the impacts on the BOP account during, and as a result of, construction are expected to be negligible.

4.12.3.9. Impact on supply/demand of extractive resources

Given the scope of the project and the alignment of the pipeline, impacts on the supply and / or demand of extractive resources will be unlikely (as the pipeline does not transect any extractive resource areas and the pipeline route has been aligned following consultation with underlying tenement holders – mining).

4.12.3.10. Economic impacts of hazards

Based on the information provided at the time of writing the EIS (refer to Section 4.13), it is unlikely that there will be adverse economic impacts of any potential hazards identified within the project area.

4.12.3.11. Potential for local investment

Once commissioned and operating, the project may be on-sold to and operated by a third party. As such, the potential for direct equity investment by local businesses or the community is low. However, indirect ownership of the project through superannuation funds is likely for the wider community.

4.12.3.12. Benefit Enhancement and risk

Expected economic benefits from the project include:

- Increased output in the project area;
- Increased output in Queensland;
- Increased output in the national economy;
- Increased employment in the project area;
- Increased employment in Queensland;
- Increased employment in Australia;
- Increased household income in the project area;
- Increased household income in Queensland;
- Increased household income in Australia; and
- Increased LNG production (cumulative).

Potential risks and likelihoods include:

- Unemployment following construction – Low;
- Employment is transferred from other businesses - Low; and
- BOP changes – Low.

4.12.4. SUMMARY

Economic impacts associated with the project have been assessed for all stages of the project including, construction, commissioning, operation, and decommissioning. Overall, the project is estimated to contribute significant economic gains to the project area and the domestic economy. This is especially during construction, by generating an estimated total output impact of $2.9 billion, as well as supporting an estimated annual average of 2,952 FTE jobs during construction, 28 FTE jobs during operation, and contributing $627 million in household income over the life of the project. The project is aligned with local government policies and aspirations, supporting and strengthening the Australian economy.

Specifically, the project is expected to provide a number of economic benefits to the project area and well as Queensland and Australia including:

- Contribution to output;
- Contribution to household income;
- Contribution to employment; and
- An indirect contribution to energy self sufficiency and security of supply, and the continued prosperity of the Australian economy.

While some economic risks have been identified in the project area, they are generally low and cumulative impacts associated with significant projects in the project area are negligible.

A summary of key project commitments against each of the potential impacts is discussed in **Table 4-107**.

Table 4-107: Key project commitments

Issue	Commitment
Local, regional and national economic prosperity	▪ Provided that the net benefit of the project is not undermined, locally sourced inputs (labour and materials) will be examined to enhance the economic benefit to project area, QLD and domestic economy.
Regional unemployment Reduction in unemployment rate and benefits paid by the Government	▪ Labour will be sourced locally where possible despite expectation of a FIFO arrangement.

4.13. HAZARD AND RISK

This section identifies and describes the hazards and risks to which people and property will be potentially exposed during construction and operation of the project. Hazards and risks related to natural hazards are also examined with respect to floods, bushfires, landslides and seismic hazards, including earthquakes.

Legislation, policies and guidelines

The assessment of hazard and risk associated with the project is based on applicable legislation, policies and guidelines outlined in **Table 4-108**.

Table 4-108: Legislation, policy and guidelines for hazard and risk

Legislation	Relevance
Dangerous Goods Safety Management Act 2001	Regulates the safe management of storage and handling of hazardous materials, particularly dangerous goods and combustible liquids, and the management of major hazard facilities and emergencies involving hazardous materials, and for other purposes.
Land Protection (Pest and Stock Route Management) Act 2002	Regulates the spread of declared pests, including, for example, preventing their spread by human activity.
Workplace Health and Safety Act 1995	Concerned with workplace health and safety and related purposes.
State Planning Policies (SPPs)	Relevant SPP for hazard and risk: State Planning Policy (SPP) 1/03 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide.*
Guidelines for the Preparation of a Transport Emergency Response Plan	To meet obligations under Dangerous Goods legislation, transport operators are required to have an emergency response plan for dealing with any dangerous goods situation arising from the transport of dangerous goods by road or rail.

Relevant national and international standards

The applicable Australian Standards for hazard and risk include:

- *AS 2885.1 2007: Pipelines - Gas and Liquid Petroleum*;
- *AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines*;
- *AS 1216 – 2006: Classification, Hazard identification and Information Systems for Dangerous Goods*;
- *AS 1940 – 2004: Storage and Handling of Flammable and Combustible Liquids*;

- *AS 3780 – 2008: The Storage and Handling of Corrosive Substances*;
- *AS 2809 – 2008: Road Tank Vehicles for Dangerous Goods*; and
- *AS 2931– 1999: Selection of Use of Emergency Procedure Guides for Transport of Dangerous Goods*.

Methodology

A preliminary hazard and risk analysis has been undertaken based on the principles and guidelines of *AS/NZS ISO 31000: 2009 Risk Management* and Arrow Energy's risk management procedures.

For the purposes of this assessment, the following definitions of hazards and risks apply:

- Risk – effect of uncertainty on objectives (AS/NZS ISO 31000); and
- Hazard – anything that has the potential to cause harm in terms of human injury or ill health, damage to plant, damage to the environment (Arrow Energy - Risk Management Procedure).

A semi-quantitative analysis for hazards and risks has been carried out with respect to:

- Relevant hazards, both technological and natural;
- The possible frequency of potential hazards, accidents, spillages and abnormal events occurring;
- Cumulative risks to surrounding land uses;
- Life of any identified hazards;
- Hazardous substances to be used, stored, processed, produced or transported;
- The rate of usage of substances;
- Type of machinery and equipment used;
- Potential wildlife hazards; and
- Public liability of the State for private infrastructure and visitors on public land.

Accordingly, the assessment has included the following components:

- Hazard and receptor identification;
- Hazard and risk analysis;
- Hazard and risk evaluation; and

- Hazard and risk treatment.

A requirement of AS 2885.1 during the preliminary design phase is the preparation of an Initial Safety Management Study (initial SMS). The Initial SMS was conducted by GHD in August 2011 to determine high consequence events and their proposed controls. The Initial SMS was reviewed as part of the hazard and risk assessment and is provided in **Appendix A4.6**, **Volume 3**.

4.13.1. DESCRIPTION OF VALUES

The environmental values within the project area likely to be affected by potentially hazardous or risk related events include sensitive receptors within a 1 km buffer either side of the proposed pipeline route. There are 123 sensitive receptors within a 1 km buffer of the proposed pipeline route, 119 of these sensitive receptors being residential dwellings.

4.13.1.1. Natural hazards

A natural hazard is a naturally occurring situation or condition with the potential for loss or harm to the community or environment. Effective land use planning is an important means of reducing the community's vulnerability to natural hazards and promoting resilient communities. Cyclones and earthquakes are also considered to be natural hazards but are addressed in **Section 4.1** and **Section 4.2** respectively.

SPP 2/02 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* applies to the project (refer **Section 1.5.2.4**) and requires the identification of natural hazard management areas, within which minimising risks to the community should be a key consideration in development assessment and the preparation of planning schemes. Natural hazard management areas include:

- Flood – a natural hazard management area (flood) is land inundated by a Defined Flood Event (DFE) and identified in a planning scheme. The DFE is the flood event adopted by a local government for the management of development in a particular locality. The DFE is generally not the full extent of flood-prone land;
- Bushfire – generally an area identified by a local government in its planning scheme, reflecting the ‗medium' and ‗high' hazard areas of the Bushfire Risk Analysis maps, as modelled by the Rural Fire Service of the Queensland Fire and Rescue Service (QFRS); and
- Landslide – all land with a slope of 15% or greater and suspected as being geologically unstable. A landslide occurs where sections of land break away and move large distances in a short time period. A landslip is a movement of the land surface and sub-surface over relatively short distances and possibly long timeframes.

A desktop study and site visit has been conducted by Arup (2011) as part of preliminary geotechnical investigations to identify geohazards. These are features generally requiring special engineering measures to ameliorate their effects and include areas with slope instability and seismic hazards. Geohazards were assessed for the pipeline using published geologic and soil mapping, relevant geotechnical reports, topographic surveys and aerial imagery.

Flood hazard

The proposed pipeline route traverses watercourses of varying sizes, including the Isaac and Fitzroy River. The majority of the creeks identified are ephemeral in nature but may experience flash flooding during heavy rainfall events. A detailed description of watercourses traversed by the project is provided in **Section 4.5**.

To the south of Rockhampton, the project area passes through the alluvial plains of the Fitzroy River (AB320.2) and its tributaries. The Fitzroy River catchment is capable of producing severe flooding following heavy rainfall events. The most recent major flood for the Fitzroy River spanned over the end of December 2010 and early January 2011.

Bushfire hazard

Bushfire modelling conducted by the Rural Fire Service of the QFRS shows that the majority of the proposed pipeline route runs through low or medium risk areas. The pipeline will be constructed of steel and will be buried and as such bushfires will not pose a threat to the integrity of the pipeline.

Landslide hazard

Slope analysis data collected by the Shuttle Radar Topographic Mission (SRTM) has been processed to identify land with a slope of 15% or greater and the results shown in **Figure 4-24** (CGIAR-CSI, 2006). The majority of the proposed pipeline route traverses predominantly flat or undulating topography which is gently sloping (refer **Section 4.2.1.1**). According to the Geosciences Australia landslide database, there are no records of landslides in the project area. This shows that the terrain is not generally prone to landslides.

As part of preliminary geotechnical investigations to identify geohazards, twelve locations were identified where there is a potential hazard from slope instability (Arup, 2011). Potential landslide hazard areas are illustrated in **Figure 4-24**.

Seismic hazards

The proposed pipeline route crosses several faults, some of which are active. Seismic hazards (including faulting and earthquakes) have been detailed in **Section 4.2.1.3** and is summarised as follows.

A geotechnical desktop study undertaken by Arup (2011) identified 12 areas of potential slope instability where the proposed pipeline routes crosses steep slopes and a possible ancient landslide. The proposed pipeline route runs along one potentially active fault, the Dee Range / Midgee Fault, for approximately 14 km between AB411 and AB425 (Arup, 2011).

Low to intermediate seismic events have occurred in the project area during the last 120 years (Arup, 2011). Recent earthquakes in the Moranbah area demonstrate that certain faults in the Bowen Basin are active including an earthquake that measured 5.2 on 17 April 2011 and another that measured 4.1 on 19 September 2011. Earthquakes in the Moranbah area with magnitudes generally less than 4.0 are attributed to significant mining operations.

A review of records held by Geoscience Australia (2011) show that 23 earthquakes have occurred in the project area since records began in 1955. Only two were classed as ‗significant' with magnitudes of 3.6 and 4.2. The 3.6 magnitude earthquake occurred in 1990 at 10 km below surface and was possibly associated with a concealed fault where the pipeline crosses at approximately AB121. Six earthquakes with magnitudes of between 0.8 and 2.9 appear to have occurred near the proposed pipeline route in the Bajool area near Port Alma in association with the deformed zone between AB427 and AB428. The remainder of the recorded earthquakes do not appear to be associated with faults where the proposed pipeline route crosses.

ARROW BOWEN PIPELINE PRELIMINARY ROUTE (REV D)

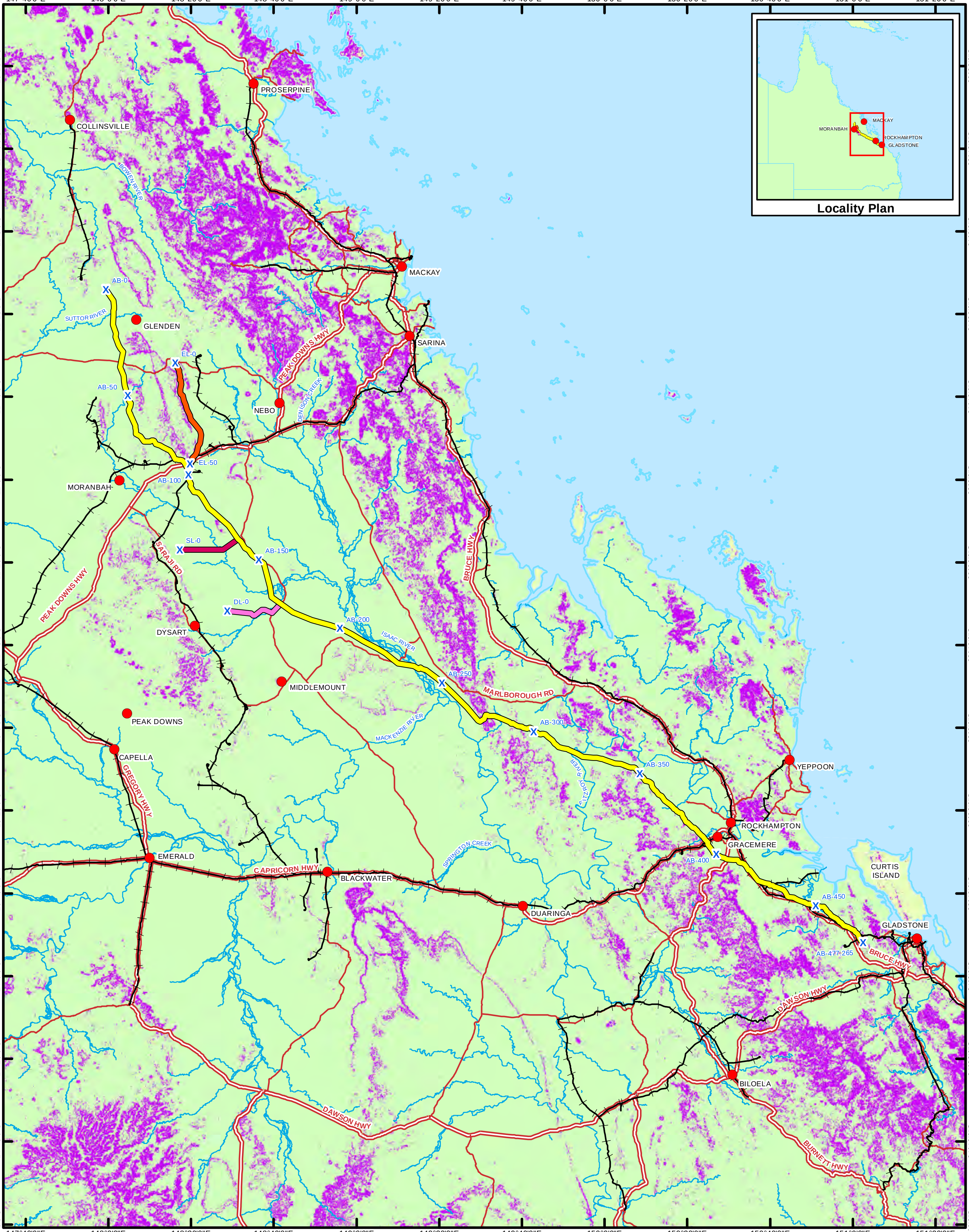


Figure 4 - 24: Potential landslide hazard areas (slope > 15%)

Legend

- Localities
- Kilometre Points
- AB Mainline Rev D
- Dysart Lateral Rev D
- Elphinstone Lateral Rev D
- Saraji Lateral Rev D
- Railways
- Highways
- Major Roads
- Major Watercourses
- Potential Landslide Hazard Areas - Slope > 15%

Data Sources:
StreetPro: Localities, Roads, Railways
Slope Analysis using DEM Shuttle
Radar Topography Mission
DERM: Major Watercourses
Data Supplied by Arrow Energy:
ABP Mainline RevD,
ABP Lateral RevD
Kilometre Points

N

0 25 50
Kilometres

Scale: 1:2,250,000 @ A4
Coordinate System: GCS GDA 1994

Document: I:\ENVR\Projects\EN02962\Spatial\ArcGIS\V1\Figure_4_24_Potential_Landslide_Hazard_Area_A4.mxd Date: 1/03/2012

NOT FOR CONSTRUCTION

4.13.2. POTENTIAL IMPACTS AND MITIGATION MEASURES

4.13.2.1. Hazard and risk assessment

Hazards or risks which could occur were identified through consideration of the anticipated works required during construction and the proposed activities present during operation. The key hazards and risks are as follows:

Construction

- Construction activities impacting on major crossings, such as roads, railways, watercourses and potential disruption to buried services (e.g. severance of electricity, telecoms and water services);
- The use, storage and transport of any hazardous materials or dangerous goods, including oils, fuels, chemicals, lubricants, solvents or biocides;
- Transport and access of construction materials;
- Bushfire initiated by construction activities; and
- Natural hazards from potential floods, bushfires, landslides or earthquakes.

Construction processes, machinery and equipment (as described in **Chapter 3**) are anticipated to include:

- Clear and grade;
- Stringing and welding;
- Joint coating;
- Trenching;
- Lowering-in and backfilling;
- Blasting;
- Crushing;
- Traffic; and
- Clean-up, restoration and rehabilitation.

Operation

- Pigging;
- Accidental release of gas / explosion (e.g. pipeline incident from excavations, pipeline corrosion, equipment failure, incorrect temporary storage or containment of hazardous substances);
- Natural hazards from potential floods, bushfires, landslides or earthquakes impacting on the pipeline and/or facilities; and
- Bushfire initiated by pipeline maintenance activities or by third party.

These risks are preliminary and will be reviewed, assessed and quantified progressively as the project proceeds.

Risk analysis

Risk criteria (**Table 4-109**) were developed for the project, enabling the assessment of the potential likelihood and resulting consequence if each hazard were to occur. The risk matrix and impact / likelihood descriptions used are provided in **Table 4-110**. The evaluation of workforce/public health and safety and potential natural hazards has been based on the likelihood and impact of a particular event occurring.

Likelihood was measured on a five point scale of A (rare) and E (almost certain), whilst impact has been assessed on a scale from 1 (low) to 5 (high).

By assigning consequence and likelihood ratings for each of the potential hazards and risks, the level of risk was determined using a qualitative risk assessment matrix. A risk rating of 1-3 is categorised as ‗low', between 4-9 as ‗medium', between 10-14 as ‗significant' and between 15-25 as ‗high'. Hazards that represent a higher risk have the highest priority for implementing additional risk controls. Low risk hazards will be subject to existing operational controls and routine procedures that will be continuously reviewed.

The preliminary hazard identification and risk assessment for construction is provided in **Table 4-111** and **Table 4-112** and in **Table 4-113** and **Table 4-114** for operation. This details the key potential hazards and their associated risks and assesses the likelihood of occurrence and potential consequences of risks associated with each issue. Following this assessment, identification of hazards and risks and their relative priority, mitigation or adaptation measures are proposed to mitigate potential hazards and risks. Residual effects are then evaluated after mitigation measures have been implemented. Residual hazards and risks for the overall impact assessment range from 1 (insignificant) to 5 (catastrophic).

Table 4-109: Risk criteria

Risk Ranking Matrix				Likelihood				
				Low		Moderate	High	
Impact	Health and Safety	Consequence		Rare	Unlikely	Moderate	Likely	Almost certain
				A	B	C	D	E
High Impact	More than 3 fatalities	Serious long term effect	5	5	10	15	20	25
	Up to 3 fatalities / permanent, serious disability	Serious medium to long term effect	4	4	8	12	16	20
Moderate Impact	Moderate, irreversible impairment	Moderate short term to medium term effect	3	3	6	9	12	15
Low Impact	Objective, but recoverable impairment	Minor short term effect	2	2	4	6	8	10
	First aid / minor	Low level / no lasting effect	1	1	2	3	4	5

				Management action
Risk Rating	15-25	High	Unacceptable risk	Risk must be reduced as a priority, with close monitoring and regular review
	10-14	Significant	Tolerable risk	Reduce risk as a priority, closely monitor and regular review
	4-9	Medium		Reduce risk where possible, monitor and review
	1-3	Low	Broadly acceptable	Generally acceptable - manage by routine procedure

Source: Arrow Energy Risk Management Procedure: 99-H-PR-0017, Rev: 7

Table 4-110: Risk matrix and impact / likelihood descriptions

Risk Assessment Timeframe	Likelihood				
	Rare	Unlikely	Moderate	Likely	Almost Certain
	A	B	C	D	E
	The consequence is highly unlikely to occur within the time scope of the assessment	The consequence is unlikely to occur within the time scope of the assessment	The consequence may occur within the time scope of the assessment	The consequence will probably occur within the time scope of the assessment	The consequence is expected to occur within the time scope of the assessment
Individual Projects:	0-1% chance of occurring during project	2-20% chance of occurring during project	21-50% chance of occurring during project	51-80% chance of occurring during project	> 80% chance of occurring during project
For a 5 year project, this equates to a frequency of:	Approximately once every 1000 years	Approximately once every 45 years	Approximately once every 14 years	Approximately once every 8 years	Approximately once every 5 years
Operational Asset:	0-1% chance of occurring during design life of facility	2-20% chance of occurring during design life of facility	21-50% chance of occurring during design life of facility	51-80% chance of occurring during design life of facility	> 80% chance of occurring during design life of facility
For an asset with a 50 year design life, this equates to a frequency of:	Approximately once every 10000 years	Approximately once every 450 years	Approximately once every 142 years	Approximately once every 77 years	Approximately once every 50 years

Overall Impact Assessment				
Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
1	**2**	**3**	**4**	**5**
Environmental Impact				
No lasting effect. Low level impacts on biological or physical environment. Limited damage to minimal area of low significance	Minor effects on biological or physical environment. Minor short term damage to small area of limited significance	Moderate effects on biological or physical environment but not affecting ecosystem function. Moderate short to medium term widespread impacts	Serious environmental effects with some impairment of ecosystem function (eg displacement of a species). Relatively widespread medium to long term effect	Very serious environmental effects with impairment of ecosystem function. Long term, widespread effects on significant environment (e.g. unique habitat)
Health and Safety Impact				
Low level short term subjective inconvenience or symptoms. First Aid may be required.	Objective but reversible disability/impairment and/or medical treatment injuries requiring hospitalization.	Moderate irreversible disability or impairment (<30%) to one or more persons.	Up to three fatalities and/or severe irreversible disability or impairment (>30%) to one or more persons.	More than three fatalities, or significant irreversible disability or impairment to more than 50 persons.

Source: Arrow Energy Risk Management Procedure: 99-H-PR-0017, Rev: 7

Table 4-111: Hazard and risk register – construction activities

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Existing utilities (eg water, electricity, telecoms)	Severance or disruption of pipes, cables.	Project workforce. Local residents.	Disruption to utility services.	3	B	6	Third party infrastructure in the ROW will be accurately identified prior to trenching activities. Early consultation with affected stakeholders. Compliance with permitting requirements.	2
Construction vehicle incident	Vehicle accident from road collision or congestion on road network.	Project workforce. Local residents.	Injuries or incidents to construction personnel and local residents.	2	C	6	Construction TMP. Construction Emergency Response Plan.	1
Falls, slips or trips	Construction staff unaware of risk of falls/slips/trips. Appropriate and safe equipment not utilised during construction.	Project workforce.	Injuries or incidents to construction personnel.	2	C	6	Construction SMP. Construction Emergency Response Plan.	1

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Dust	Works generating excessive dust emissions during construction.	Project workforce. Local residents.	Health impacts on construction personnel (breathing, eye injuries) and nearby residents. Dust nuisance.	1	C	3	Construction EMP. Water trucks will be used where necessary (particularly in hot and windy conditions) to reduce dust generation.	1
Noise and vibration	Works generating excessive noise and/or vibration during construction.	Project workforce. Local residents.	Health impacts on construction personnel (hearing impairment) and nearby residents (human health, well being)	2	B	4	Construction EMP.	1
Waste	Incorrect storage, handling, use or transportation of hazardous substances or dangerous goods	Local residents.	Health and /or amenity impacts on nearby residents	C	3	9	Waste and dangerous goods management strategies (Construction EMP, compliance with the requirements of AS1940).	1
Land - soils	Soil erosion and sedimentation from project works	Agriculture Water reserves	Damage to agriculture. Loss or damage to water reserves.	3	C	9	Construction EMP. Erosion and sediment control measures implemented as required.	1

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Land - temporary workers' accommodation camps and construction compounds	Fires, spillages of hazardous substances	Nearby homesteads Agriculture	Nuisance to nearby homesteads. Loss or damage to agriculture.	B	3	6	Appropriate site selection and local government planning approval for temporary workers' accommodation camps and construction compounds. Fire Risk Management Plan.	1
Land – Potential Acid Sulphate Soils and contaminated land	Encountering Acid Sulphate Soils or contaminated land requiring specific storage, handling and amelioration	Local land use	Damage to surrounding land use practices	3	B	6	Construction EMP to incorporate Acid Sulfate Soils and contaminated land management strategies.	1
Accidental release of liquid, gaseous or particulate pollutants or other hazardous materials	Incorrect storage, handling, use or transportation of hazardous substances or dangerous goods	Project workforce Local communities Agriculture	Injury or incidents to construction personnel and local communities	2	C	6	Construction EMP to address dangerous goods management (including storage and use of flammable and combustible substances). Construction Emergency Response Plan. Hazard and Operability (HAZOP) study.	2

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Wildlife hazards	Exposure to vector-borne diseases, venomous wildlife or insects	Project workforce	Injury or incidents to construction personnel	3	B	6	Identifying and controlling potential biological hazards. Ensuring workers are aware of potential wildlife hazards. Providing adequate information, supervision, instruction and training. Use of Personnel Protective Equipment (PPE). Regular health monitoring.	2

Table 4-112: Hazard and risk register – construction: natural hazards

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Flood	Inundation of construction area	Project workforce. Project plant and equipment. Temporary workers' accommodation camps. Local communities.	Incidents to construction personnel. Loss or damage to plant, equipment or worksites. Loss or damage to property. Delays arising from access restrictions.	2	B	4	Contingency plans to account for natural events. Construction Emergency Response Plan. Location of temporary workers' accommodation to consider potential for flooding	1
Bushfire	Works potentially exacerbating effects of bushfires. Works starting bushfires.	Project workforce. Project plant and Equipment. Temporary workers' accommodation camps.	Injury or incidents to construction personnel. Loss or damage to plant, equipment or worksites. Loss or damage to property.	2	C	6	Construction Safety Plan Construction Fire Risk Management Plan. Construction Emergency Response Plan. Dangerous goods shall be stored and handled in accordance with relevant legislation and standards. Permit to work system for all hot work.	1
Landslide	Construction impacted by extreme event	Project workforce. Project plant	Injury or incidents to construction personnel.	3	A	3	Pre-construction geotechnical studies. Construction EMP.	1

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Flood	Inundation of construction area	Project workforce. Project plant and equipment. Temporary workers' accommodation camps. Local communities.	Incidents to construction personnel. Loss or damage to plant, equipment or worksites. Loss or damage to property. Delays arising from access restrictions.	2	B	4	Contingency plans to account for natural events. Construction Emergency Response Plan. Location of temporary workers' accommodation to consider potential for flooding	1
		and equipment. Temporary workers' accommodation camps.	Loss or damage to plant, equipment or worksites. Loss or damage to property.				Using appropriate construction equipment and techniques. Construction Emergency Response Plan.	
Earthquake	Construction impacted by extreme event	Project workforce. Project plant and equipment. Temporary workers' accommodation camps.	Injury or incidents to construction personnel. Loss or damage to plant, equipment or worksites. Loss or damage to property	3	A	3	Construction Emergency Response Plan.	1

Table 4-113: Hazard and risk register – operations activities

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Loss of containment from corrosion or mechanical failure	Explosion, fires	Project infrastructure. Local communities. Agriculture.	Potential injury or incidents to property / local communities. Potential fires.	5	B	10	Pipeline design in accordance with AS 2885.1. Prevent pipeline corrosion with external protective coating and cathodic protection system. HAZOP study. Install systems to continuously monitor gas flows and pipeline pressure. Systems will close automatically on detection of an excessive rate of change in pressure. Regular patrolling / inspections and maintenance of pipeline easement. Implement incident management procedures, including operations Emergency Response Plan/Procedures.	1

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Fire	Operator activities or facilities starting a bushfire	Project infrastructure. Local communities.	Damage to project infrastructure. Injury or incidents to operations personnel and local communities. Loss or damage to property, agriculture.	5	A	5	Bury pipeline to protect from fire hazards in accordance with AS 2885. Permit to work systems for control of hot work. Develop and implement incident management procedures, including an operations Emergency Response Plan / Procedures to include: - inherently safe design standards. - engineering controls. - administrative controls. - physical protection measures.	1
Adjacent oil or gas pipelines: - maintenance activities catastrophic failure.	Pipeline rupture, potentially resulting in explosion or fires	Project infrastructure. Local communities.	Damage to project infrastructure. Injury or incidents to operations personnel and local communities. Loss or damage to property, agriculture.	5	A	5	Adequate separation distances. Third party operator liaison. Dial before you dig. Regular patrolling / inspections and maintenance of pipeline easement.	2

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Induced voltages from high voltage power lines	Voltage induced on a pipeline from overhead power lines either by capacitance, conductance or induction	Project infrastructure. Local communities.	Damage to project infrastructure. Injury or incidents to operations personnel and local communities.	5	A	5	Avoid long parallel runs of the pipeline adjacent to high voltage power transmission lines. Increase distance between the pipeline and the power transmission line. Install shield wires on power transmission lines.	1
Pipeline incident from third party interference, eg: mechanical ploughing, contour forming, utilities excavations	Pipeline rupture, potentially resulting in explosion or fires	Project infrastructure. Local communities.	Damage to project infrastructure. Injury or incidents to operations personnel and local communities. Loss or damage to property, agriculture.	5	C	15	Construct pipeline in accordance with AS 2885.1 to protect from mechanical ploughing and excavation activities (e.g. utility services). Provide heavy wall pipe and increase depth of cover in potential high consequence areas. Install security fencing, gates and locks around all major above ground facilities (e.g.valves) to inhibit accidental damage or unauthorised tampering. Erect pipeline marker signs. Operate according to the Pipeline Protection Safety Measures and in accordance with an approved Emergency	2

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
							Response Plan.	
Land subsidence / blasting from third party works (e.g. coal)	Pipeline rupture, potentially resulting in explosion or fires	Project infrastructure. Local communities.	Damage to project infrastructure from localised subsidence.	5	A	5	Mine or quarry owner liaison where risks are identified. Geotechnical evaluation at detailed design. Regular patrolling / inspections and maintenance of pipeline easement.	2
Road or rail crossings	Pipeline rupture, potentially resulting in explosion or fires.	Project infrastructure. Local communities.	Damage to project infrastructure. Injury or incidents to operations personnel and local communities. Loss or damage to property, agriculture.	4	B	8	Provide heavy wall pipe or increase depth of cover in potential high consequence areas, in accordance with AS 2885.1. Third party liaison. Dial Before You Dig. Regular patrolling / inspections and maintenance of pipeline easement. Signage maintenance.	2

Table 4-114: Hazard and risk register – operations: natural hazards

Potential Hazard	Description of Risk	Likely Resources / Receptors Affected	Consequence	Impact	Likelihood	Risk	Mitigation Measures	Residual Risk
Flood, bushfire, landslide, earthquake	Extreme climatic events	Project infrastructure. Local communities.	Damage to project infrastructure. Injury or incidents to operations personnel and local communities.	1	D	4	Inherently safe design standards. Engineering controls. Administrative controls. Physical protection measures including: - clearing surrounding vegetation in vicinity of above ground infrastructure - burying pipeline to protect from climatic hazards; and - reducing buoyancy of pipeline at water crossings and areas of significant inundation. Develop and implement incident management procedures, including operations Emergency Response Plan / Procedures.	1

The results of the hazard identification and risk assessment show that none of the residual risks are classified above a minor level of risk. No major or catastrophic residual risks have been identified. As such, residual hazard and risks are considered to be effectively managed by the proposed control measures described in the following section.

4.13.2.2. Hazard and risk mitigation measures

Risks associated with the identified hazards and risks will be mitigated by the implementation of appropriate prevention, detection and protection measures to reduce the probability of such events occurring. These will be incorporated into management plans for the construction and operations phase.

The mitigation measures identified within this section will be supplemented by the *Code of Environmental Practice* produced by the Australian Pipeline Industry Association (APIA, 2009). This code provides guidance for managing the environmental aspects of pipeline planning, design, construction, operation and decommissioning.

The legislation, policies and standards listed in **Table 4-108** will also be enforced to ensure a safe working environment is maintained for the construction and operations workforce and surrounding residential communities. All activities associated with the project conducted will be subject to legislative standards.

Inherently safer design

As part of the design process, the following risk studies will be conducted by the proponent:

- A Pipeline Safety Management Study, prepared in accordance with AS 2885.1.
- HAZOP Study for any above ground facilities.

A ‗Line Pipe Fracture Control Plan' will be developed as part of the Pipeline Safety Management Study to ensure that residual risks are reduced to a low level.

Emergency Response Plan

An ERP will be prepared for all likely emergency situations and incidents that could occur as a result of project construction or operations by natural hazards, systems and equipment failure or by human error.

Risks specific to the project which could give rise to emergency situations include:

- The accidental releases of liquid, gaseous or particulate pollutants or other hazardous materials;
- Natural hazards, such as floods bushfires landslides or earthquakes;
- Incidents involving construction vehicles; and

- Pipeline incidents from third party interference.

Dedicated first aid and emergency rescue facilities and equipment will be available during the construction and operation phases. Appropriately trained personnel will be available to provide first aid and emergency response to on site emergencies. First aid response and provision will be included in site induction training that will be provided to all staff members. Induction training will include fire response techniques.

Emergency response planning will include relevant information in SPP 1/03 to account for natural hazards during the construction, operation and maintenance phases.

First aid and fire fighting equipment will be provided for construction activities, such as welding, grinding and the use of heating torches, where there is an elevated risk of fire. Site fire fighting capabilities will be addressed in the ERP.

The ERP will involve the relevant state agencies (such as the Department of Emergency Services, which includes the Queensland Ambulance Service, Queensland Fire and Rescue Service and Emergency Management Queensland) in relation to emergency medical response and transport and first aid matters. The ERP will assess transport access for emergency services. Discussions will be held with emergency services to identify any project site access issues. The ERP will be developed in consultation with local emergency services such as Police, fire services and State Emergency Services personnel as well as the local emergency response groups.

Property safeguards

Safeguarding the local community will be implemented through a ‗safety in depth' or ‗defence in depth' approach, where there exists a multi-layered approach to preventing public and environmental impacts. These safeguards will principally comprise:

- The design, construction and operation of the pipeline using best practice techniques and methods presently available; and
- The implementation of safety management systems and emergency response planning appropriate for the hazards involved.

Good engineering practice involves, as a minimum, designing in accordance with Australian Standards and industry codes of practice as well as using formal safety in design practices for reviews and issue management. The safety systems of this approach include:

- Continuous monitoring and control;
- Fire prevention, detection and fighting procedures; and
- Emergency Response Plan procedures for on-site or off-site events.

Dangerous goods, including flammable and combustible substances

Potential hazards are substances and chemicals which require transport, storage and handling. The project will use hazardous substances which are regulated by the Australian Dangerous Goods Code.

An inventory of dangerous goods and hazardous substances listed in the *Australian Dangerous Goods Code* which may be used in construction is provided in **Table 4-115**.

Table 4-115: Indicative schedule of dangerous goods and hazardous substances – construction

Chemical Name/ Shipping Name	DG Class	Raw conc. (wt%)	Storage conc. (wt%)	UN No.	Packaging group	Purpose/Use
Diesel fuel oil	3 (Class C1)*	N/A	N/A	1202	III	Fuel for mobile equipment
Lubrication oils (hydraulic oil)	3 (Class C2)**	N/A	N/A	N/A	N/A	Lubricate plant and equipment
Solvents (e.g. acetone)	3	99.5	99.5	1090	II	Degreasing agent
Paints	3	N/A	N/A	1263	III	Paint

*Class C1 - a combustible liquid that has a flashpoint of 150°C or less.

**Class C2 - a combustible liquid that has a flashpoint exceeding 150°C.

Construction activities will use relatively small quantities of chemicals and fuel, and therefore potential spill volumes will be low. However, without appropriate controls, project related activities may result in localised impacts on natural resources, such as soils, surface water or groundwater contamination from spills of fuel or chemicals.

All hazardous substances will be brought to the construction site as required and not stored in bulk.

Controls for managing dangerous goods or hazardous substances during construction will be specified within the EMP (refer to **Chapter 5**). The following management measures will be implemented:

- The implementation of a Dangerous Goods Management Plan and ERP;
- The transport of dangerous goods in accordance with the relevant legislation and standards, including AS 1678 (2004), AS 2809 (2008) and AS 2931 (1999);
- The proper storage and handling of hazardous materials, such as chemicals, in accordance with relevant Australian Standards and Material Safety Data Sheets (MSDS). This documentation, including schedules of potentially hazardous materials on worksites and their relevant MSDSs, will be made readily available to all employees and contractors working on the project;

- Ignition sources will be strictly controlled and limited to avoid a fire;
- Fire fighting equipment will be provided at all temporary workers‘ accommodation camps and during all hot work (e.g. welding);
- Tanks will be bunded to contain spills, where required in accordance with AS 1940 (2004). The minimum bunded capacity will be in accordance with AS1940. The net capacity of the bunds will be 110% of the total capacity of all tanks within each compound. Bund and tank integrity will be monitored on a regular basis to protect against leakage;
- All tanks will be located in cleared areas to minimise both the risk of creating a bushfire and bushfires impacting on fuel storage areas;
- Construction equipment will be refuelled by appropriately trained and qualified staff on the ROW or at purpose built areas at temporary workers‘ accommodation worker camps or facility compounds, as applicable;
- No refuelling of plant and equipment will be undertaken within 50 m of watercourses;
- Spill kits containing absorbent and containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use;
- Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at a designated site, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area;
- Regular visual inspections and maintenance of storage facilities to detect faults or housekeeping issues; and
- Site training for appropriate materials handling and environmental awareness to encourage good material handling practices, spill management and incident reporting.

During operation, the principal hazards will be associated with substances being stored and used for maintenance activities. Details of the materials stored on site during operation are provided in **Table 4-116**.

Table 4-116: Indicative schedule of dangerous goods and hazardous substances – operation

Chemical Name/ Shipping Name	DG Class	Raw conc. (wt%)	Storage conc. (wt%)	UN No.	Packaging group	Purpose/Use
Diesel fuel oil	3 (Class C1)*	N/A	N/A	1202	III	Fuel for mobile equipment for maintenance
Lubrication oils (hydraulic oil)	3 (Class C2)**	N/A	N/A	N/A	N/A	Lubricate plant and equipment for maintenance
Solvents (e.g. acetone)	3	99.5	99.5	1090	II	Degreasing agent
Paints	3	N/A	N/A	1263	III	Paint

*Class C1 - a combustible liquid that has a flashpoint of 150°C or less.

**Class C2 - a combustible liquid that has a flashpoint exceeding 150°C.

MSDS information will be made readily available to all site personnel involved in the storage and handling of hazardous substances and materials. The storage, handling and use of these materials will be in accordance with current Australian Standards and industry codes of practice.

Transport of dangerous goods

All dangerous goods transported during construction and operation will be undertaken by licensed operators in compliance with the Australian Dangerous Goods Code. The potential for off-site transport accidents will be minimised by the following:

- Developing and implementing a TMP in consultation with local government, DTMR and the Department of Community Safety (refer to **Section 4.3**);
- Managing access routes to minimise impacts on communities on designated routes;
- Applying speed and weight restrictions to project vehicles as appropriate, especially on unsealed roads;
- Maintaining all haulage vehicles to a high standard in relation to traffic safety and operational safety; and
- Driver safety training, including incident response procedures and environmental awareness.

With the implementation of appropriate controls during construction and operation, minor residual risks are anticipated from the transport, storage or handling of dangerous goods.

Construction vehicles, machinery and equipment

An inspection and maintenance schedule will be implemented for plant and equipment used at construction worksites. Equipment will be maintained to ensure that plant and equipment remains in good working order. All vehicle, machinery and equipment operators will be trained and carry relevant licences, where required.

With mitigation in place, insignificant residual risks are predicted from vehicles, equipment or machinery used during construction of the pipeline.

Natural hazards

Flood

The specific outcome for flood hazard areas described in SPP 1/03 is to ensure the safety of people and minimise the potential damage from flooding to property.

Temporary workers' accommodation camps and construction compounds will be suitably sited following consideration to potential flooding. Watercourse crossings will be completed promptly and with due regard to the weather (ie construction will be scheduled for the dry season and postponed during significant rainfall and / or flood events). In the event of flood hazards, remedial action will be undertaken in accordance with the construction ERP, where necessary.

Burying the pipeline will be the primary mitigation strategy to protect the operating pipeline from flood hazards. To reduce buoyancy at water crossings and areas of possible inundation, a concrete coating or other buoyancy control measures will be applied to the pipeline. This will be separately assessed at the detailed design stage.

Geotechnical investigations will be conducted at the major watercourse crossings to ensure appropriate construction techniques are utilised.

Accordingly, residual risks from potential flood hazards during operation are predicted to be insignificant.

Bushfire

The proposed pipeline route passes through areas of low or medium bushfire risk.

During construction, there is a potential risk of operator activities starting a bushfire. For example, construction activities such as hot work (welding and cutting), have the potential to increase the risk of fire ignition which may create bushfires. Bushfires also have the potential to impact on the pipeline during operation. The risk assessment indicates there is a potential medium risk from bushfires impacting on the project without mitigation.

Accordingly, a risk based approach will be implemented at all major project phases to minimise the risk of bushfires impacting on the project. These measures include:

- Adopting an inherently safer design – such as hazardous area zoning and appropriate design of equipment to minimise sources of ignition;
- Engineering controls – such as Emergency Shut Down;
- Administrative controls – including personnel training, visual inspections of vehicles and equipment to detect faults and Permit to Work systems to minimise ignition sources and flammable gas releases;
- Physical protection – including:
  - vegetation management;
  - burying pipelines to prevent heat damage; and
  - pipeline marking / signage to minimise potential for pipeline damage.
- Emergency response – including the provision of fire fighting equipment where hot work is being conducted; and
- Preparing and implementing construction Fire Risk Management strategies and a construction Emergency Response Plan as part of the EMP (refer to **Chapter 5**).

Adopting the above controls will reduce potential risks arising from bushfire hazards to insignificant levels.

SPP 1/03 applies to natural hazard management areas for bushfire to ensure development maintains the safety of people and property. The design, construction and operation of the pipeline will meet with the requirements of SPP 1/03 through the measures described above.

Landslide

Landslides may result in deflection, undercutting of the pipeline or damage to associated structures.

SPP 1/03 applies to natural hazard management areas for landslide, building or other work on potentially unstable slopes that involves earthworks exceeding 50 m^3 or vegetation clearing (Refer to **Section 1.5.2.4**). Development should maintain the safety of people and property from the potential risk of landslide. The potential for landslide hazards is low, given that the majority of the proposed pipeline route traverses predominantly flat or undulating topography with slopes mostly less than 15%.

To comply with SPP 1/03, potential hazards from landslides will be confirmed through field mapping and if deemed significant, through intrusive investigation prior to construction. Information gathered during these investigations will be used to inform appropriate mitigation measures to ensure the pipeline is constructed in stable ground conditions (refer to **Section 4.2**). With mitigation in place, insignificant residual risks are predicted from landslide hazards.

Seismic hazards

Potential impacts from seismic hazards include:

- Ground movements from surface or subsurface rupture resulting in damage to a pipeline or its foundations;
- Ground movements triggering landslides which may also impact on the pipeline or its foundations;
- Surface displacement from an active fault which may impact on utilities, lines of communication, and other structures; and
- Liquefaction, which may result in damage to buildings and infrastructure from ground failure and loss or weakening of building foundations.

The regional seismicity for the project is considered relatively low. The one potentially active fault (between AB411 and AB425) and a small number of potential sites with unstable slopes, will be subject to further surveys and mitigation during detailed design. To minimise potential hazards and risks from seismic hazards, information gathered during future geotechnical investigations will be used to identify appropriate mitigation measures to be implemented during detailed design (refer to **Section 4.2** for details). Accordingly, insignificant residual risks are predicted from potential seismic hazards.

Cumulative risk

Construction activities associated with other projects have the potential for cumulative risk impacts on surrounding land uses from the transport, storage, use or management of hazardous materials or substances.

Potential cumulative risks could arise from major pipeline projects that are planned, or are currently being constructed in areas within and adjoining the project area and their impacts on surrounding land uses.

The southern end of the project will be partially located in the SGIC SDA, which can accommodate a number of pipelines. The Gladstone Pacific Nickel slurry pipeline and the Fitzroy to Gladstone water pipeline have yet to be constructed but are proposed to be located in this SDA.

The proposed pipeline route will cross four other proposed CSG pipelines, namely Jemena's pipeline, Queensland Curtis LNG Pipeline, GLNG Pipeline and Australia Pacific LNG Pipeline near the Bruce Highway. A number of other major projects are also currently proposed in eastern Queensland and Gladstone.

The proposed construction schedule for the project is anticipated to commence after other pipelines currently proposed to convey CSG to Curtis Island are likely to be substantially completed, thereby avoiding significant cumulative risks during this phase. The project construction team will also look to utilise existing temporary workers' accommodation camps used for previous projects for most of the proposed pipeline route, to minimise impacts on surrounding land uses. Construction hazard and risk plans prepared for other nearby projects will be subject to careful consultation and coordination to ensure impacts are minimised on nearby land uses.

During operation, cumulative risk impacts may arise from pipeline incidents from third party interference, natural hazards, such as bushfires or pipeline corrosion leading to loss of containment. The operations phase will require the development and implementation of an effective and coordinated ERP in the event of an incident occurring due to external influences or an operations failure. This will include the development of a memorandum of understanding with emergency response services for fire and personnel safety.

Wildlife hazards

Potential wildlife hazards include vector-borne diseases, venomous wildlife/pests and insects which pose a risk to the construction workforce. Vector borne diseases may be spread to workers by insects, such as mosquitoes or ticks. Infection can take place by touching an infected animal, by eating undercooked meat, through insect, animal or reptile bites, or through contact with infected faeces or urine.

The appointed Site Safety Officer will be required to undertake a review of the construction work areas to remove the risks of exposure to wildlife hazards. Measures to control the risk from wildlife hazards will include:

- Providing adequate information, supervision, instruction and training to ensure workers are aware of potential wildlife hazards;
- First aid facilities;
- Ensuring good hygiene practices (if it is not practical to use soap and water, an alcoholic chlorhexidine hand wash or equivalent will be provided); and
- Personal Protective Equipment (PPE).

Temporary workers' accommodation camps and construction compounds will be managed to ensure activities do not encourage vermin or mosquito breeding. With mitigation measures in place, the potential for wildlife hazards is predicted to be insignificant and manageable.

Public liability

During construction, public liability and protection of the pipeline infrastructure will be managed by the appointed contractor. Measures will be in place to discourage the public from entering the construction area, including erecting warning/information signs at key locations.

During operation, security fencing, gates and locks will be provided around all major above ground facilities (e.g. valves) to inhibit accidental damage or unauthorised tampering. As the pipeline will be buried, land users will be able to resume previous land use activities on top of the pipeline. The general limitations will be related to excavation and building activities on the 30 m wide easement.

Pipeline information markers will also be erected in accordance with AS 2885. Signs will also be placed at regular intervals.

4.13.2.3. Integrated risk management plan

The integrated risk management process will commence during the design phase and will be implemented throughout construction, commissioning and operation of the pipeline, in accordance with the requirements of AS 2885.1 and AS 2885.3.

For new pipelines, AS 2885.1 requires detailed design and safety management to be undertaken as integrated iterative processes. The essential outcomes of the safety management process are:

- Assurance that the threats to the pipeline and associated risks are identified and understood by those that are responsible for addressing them; and
- Appropriate plans are made to manage these risks.

Early and routine consultation with the local councils, Emergency Services and DTMR will include:

- Arrangements for site access and egress;
- Construction staging;
- Road closures or diversions;
- Locations of temporary workers‘ accommodation camps and site compounds; and
- The transport, storage or handling of dangerous goods, including flammable and combustible substances.

Continuous management of pipeline safety is required by AS 2885.1 and AS 2885.3. Risks to the pipeline will be constantly monitored and observed, and safety controls reviewed to ensure that they remain effective. Regular reviews of the Safety Management Study will be carried out during pipeline operations.

As a part of the design, the process safety of stations, pipeline facilities and control systems will also be reviewed by a HAZOP study and, as appropriate, by other recognised safety study methods.

A Construction Safety Management Plan will be prepared following consultation with the appropriate regulatory agencies. The Construction Safety Management Plan will address the safety of construction personnel and general public for all construction activities.

A Commissioning Plan will be prepared and approved prior to pipeline commissioning. The plan will consider the safety of all activities undertaken throughout all phases of commissioning and identify safety procedures during the commissioning phase.

The outcomes of the Pipeline Safety Management Study will be incorporated into the Safety Operating Plan, as required by AS 2885.3 for the operation of a pipeline. The Safety Operating Plan will be developed in consultation with the appropriate regulatory agencies to develop risk mitigation strategies for the project and will include:

- Operating organisation structure;
- Pipeline system description;
- Pipeline Safety Management Study;
- Operational and maintenance processes and procedures;
- ERP (including impact events, fire, rupture, leaks spills, third party incidents and natural hazards) prepared in consultation with QPS and Emergency Services;
- Risk and compliance auditing; and
- Corrective action procedures.

The Safety Operating Plan will be subjected to regular compliance audits. The audits will identify any non-compliance with the plan or procedures.

The Pipeline Safety Management Study will be updated at intervals not exceeding five years or as required due to a significant change of operating conditions, a change to the state of the knowledge affecting the safety of the pipeline, or relevant legislative requirements.

4.13.2.4. Further investigations

The assessment of hazard and risks will progress through to detailed design stage as part of the Pipeline Safety Management Study. Further investigations that will be conducted include:

- Geotechnical studies;
- Proposed land uses potentially impacting on the project, such as mining operations; and
- Potential impacts from third party interference, including mechanical ploughing and consideration of appropriate protection measures.

4.13.3. SUMMARY

The preliminary hazard identification and risk assessment conducted for the project shows that the residual risks for the project are insignificant and minor. No moderate, major or catastrophic residual risks have been identified.

The majority of the hazards and risks identified are related to typical linear infrastructure construction activities which will be effectively mitigated. The key hazards and risks during operation will be managed by a comprehensive operations and maintenance program. Adherence to relevant legislation, policies, guidelines and standards for pipeline construction and operation will ensure that the probability of an incident is low.

Natural hazard management areas have been identified for flood, bushfires and landslide and measures proposed to mitigate the potential adverse effects from such events, to meet with the requirements of SPP/1/03. Future geotechnical investigations will be conducted prior to construction to minimise potential risks from seismic hazards.

Consequently, the objectives relating to minimising hazards and risks on people and property will be met during all project phases.

The key commitments with respect to hazard and risk are summarised in **Table 4-117** below.

Table 4-117: Key commitments for hazard and risk

Issue	Commitments
- Construction and operations hazards and risks. - Natural hazards. - Third party hazards, transport and access related hazards.	A detailed Safety Management Study (SMS) will be undertaken for the project in accordance with AS 288.1:2007. The SMS will ensure that all possible threats at each location are identified, evaluated and appropriately planned for and managed during pipeline construction and operation.
	The Construction Safety Management Plan will be developed in consultation with emergency response agencies
	An ERP will be prepared for all likely emergency situations and incidents that could occur as a result of project construction or operations by natural hazards, systems and equipment failure or by human error.
	The outcomes of the Pipeline Safety Management Study will be incorporated into the Safety Operating Plan, as required by AS 2885.3 for the operation of a pipeline.
	Dangerous goods shall be stored and handled in accordance with relevant legislation and standards.

4.14. CROSS-REFERENCE WITH THE TERMS OF REFERENCE

This section provides a cross-reference of each section provided in the EIS with the TOR.

Table 4-118 Cross reference with the Terms of Reference

TOR	Heading and description	EIS
	Executive summary Concise and readable summary of the project's most important aspects and options, focusing on the key issues and conclusions.	Executive summary
	Glossary of terms Glossary of technical terms, acronyms and abbreviations.	Glossary Acronyms and Abbreviations
1.0	**Introduction** Project proponent, project description, project objectives and scope, the EIS process, public consultation process, project approvals and accredited process for controlled actions under Commonwealth legislation.	Chapter 1.0
1.1	Project proponent	Section 1.1
1.2	Project description	Section 1.2 Section 3.0
1.3	Project objectives and scope	Section 1.3 Section 2.2 Section 4.12 Appendix A4.1
1.4	The EIS process	Section 1.4
1.4.1	Methodology of the EIS	Section 1.3.6 Section A1

TOR	Heading and description	EIS
1.4.2	Objectives of the EIS	Section 1.3.7
1.4.3	Submissions	Section 1.3.8
1.5	Public consultation process	Section 1.4 Appendix A4.2 Section 3
1.6	Project approvals	Section 1.5
1.6.1	Relevant legislation and policy requirements	Section 1.5.1 Appendix A2 Appendix A3
1.6.2	Planning processes and standards	Section 1.5.2 Section 4.2 Section 5.0
1.7	Accredited process for controlled actions under Commonwealth legislation	Section 1.6
2.0	**Project need and alternatives** Project justification and alternatives to the project	Chapter 2.0
2.1	Project justification	Section 2.1 Appendix A3 Section 4.10 Section 4.12 Appendix A4.1 Appendix A4.2
2.2	Alternatives to the project	Section 2.2
3.0	**Description of the project** Location, construction, operations, infrastructure requirements, waste management and rehabilitation and decommissioning	Chapter 3.0
3.1	Location	Section 3.1
3.1.1	Regional context	Section 3.1.1
3.1.2	Local context	Section 3.1.2 Appendix A4.6 Appendix A4.7
3.1.3	Co-location	Section 3.1.3
3.2	Construction	Section 3.2 Section 5.0
3.3	Operations	Section 3.3
3.3.1	Tenements and tenures	Section 3.3.1 Appendix A4.7
3.3.2	Workforce	Section 2.4 Secton 2.5 Section 3.3.2 Appendix A4.1

TOR	Heading and description	EIS
3.3.3	Workforce accommodation	Section 3.3.3
3.4	Infrastructure requirements	Section 3.4
3.4.1	Transport – road/rail/air/ship	Section 3.4.1 Section 4.3 Appendix A4.8
3.4.2	Energy	Section 3.4.2
3.4.3	Water supply and storage	Section 3.4.3 Appendix A4.9
3.4.4	Stormwater drainage	Section 3.4.4 Section 4.2.1.4 Section 4.2.3 Section 4.5.2.3 Section 4.5.3 Section 5.0
3.4.5	Sewerage	Section 3.4.5
3.4.6	Telecommunications	Section 3.4.6
3.4.7	Other infrastructure	Section 3.4.7
3.5	Waste management	Section 3.5 Section 4.4
3.5.1	Air emissions	Section 3.5.1 Section 4.6
3.5.2	Excavated waste	Section 3.5.2 Section 4.4
3.5.3	Solid waste	Section 3.5.3 Section 4.4
3.5.4	Liquid waste	Section 3.5.4 Section 4.4 Section 3.2.3
3.6	Rehabilitation and decommissioning	Section 3.6
4.0	**Environmental values and management of impacts:** Climate, land, transport, waste, water, air, noise and vibration, ecology, cultural heritage, social values, health and safety, economy and hazard and risk	Chapter 4.0
4.1	**Climate**	Section 4.1
4.1.1	Climate change adaptation	Table 4-1 Section 4.1.2 Section 4.13.2.1 Section 4.5.2 Section 4.2.2 Section 4.11.2 Section 4.6.2 Chapter 5.0 Section 4.13.2.1

TOR	Heading and description	EIS
		Section 1.5.2.6
4.2	**Land**	Section 4.2 Appendix A4.10 Appendix A4.11
4.2.1	Description of environmental values	Section 4.2.1
4.2.1.1	Topography	Section 4.2.1.1
4.2.1.2	Land use	Section 4.2.1.2 Section 1.5.1.2 Section 1.5.1.3 Section 1.5.2 Section 3.3.3 Section 4.2 Table 4-8 Section 4.2.1.2 Section 4.2.1.4 Section 4.2.1.5 Section 4.2.2.1 Section 4.2.3 Section 4.4 Section 4.5.1.4 Section 4.6.2.1 Section 4.9 Table 4-77 Section 4.13 Section 4.13.1 Section 4.13.2 Appendix A4.10 Section 3.3.1
4.2.1.3	Geology and geomorphology	Section 4.2.1.3 Appendix A4.11
4.2.1.4	Soils	Section 4.2.1.4 Appendix A4.10 Section 4.2.2.4
4.2.1.5	Contaminated land	Section 4.2.1.5
4.2.1.6	Infrastructure	Section 4.2.1.6 Section 3.4.1
4.2.1.7	Environmentally sensitive areas	Section 4.2.1.7 Section 4.8 Appendix A4.3
4.2.1.8	Landscape character	Section 4.2.1.8 Section 4.2.1.6
4.2.1.9	Visual amenity	Section 4.2.1.9

TOR	Heading and description	EIS
		Section 4.2.1.2
4.2.2	Potential impacts and mitigation measures	Section 4.2.2
4.2.2.1	Land use and suitability	Section 4.2.2.1 Section 4.2.1.2 Appendix A4.10 Section 1.5.1 Section 4.3 Section 4.4.1 Section 4.5.1 Section 4.6.2 Section 4.7.1 Section 4.8.1 Section 4.2.2.6
4.2.2.2	Land disturbance	Section 4.2.2.2 Section 3.2
4.2.2.3	Land degradation or contamination	Section 4.2.2.3 Section 4.2.2.2
4.2.2.4	Erosion and stability	Section 4.2.2.4 Section 4.2.1.4
4.2.2.5	Landscape character	Section 4.2.2.5
4.2.2.6	Visual amenity	Section 4.2.2.6
4.2.2.7	Lighting	Section 4.2.2.7
4.3	**Transport**	Section 4.3 Appendix A2 Appendix A4.8
4.3.1	Description of existing infrastructure and values	Section 4.3.1 Chapter 3 Section 3.1.2 Section 3.2.1 Section 3.4.1 Section 4.4 Section 4.4.2 Section 4.5 Section 4.5.2
4.3.2	Potential impacts and mitigation measures	Section 4.3.2 Chapter 5.0

TOR	Heading and description	EIS
4.4	**Waste**	Section 4.4
4.4.1	Description of environmental values	Chapter 3.0 Chapter 4 Section 4.1.1 Section 4.2.1 Section 4.3.1 Section 4.4.1 Section 4.5.1 Section 4.6.1 Section 4.8.1 Section 4.10.1 Section 4.11.1 Section 4.13.1
4.4.2	Potential impacts and mitigation measures	Section 4.4.2 Chapter 5.0
4.5	**Water**	Section 4.5 Appendix A4.9 Appendix A4.14
4.5.1	Description of environmental values	Section 4.5.1 Section 4.1.1 Section 4.8.1 Appendix A4.15, Section 6
4.5.2	Potential impacts and mitigation measures	Section 4.5.2 Chapter 5.0
4.6	**Air**	Section 4.6
4.6.1	Description of environmental values	Section 4.6.1 Section 4.1.1 Section 4.2.1
4.6.2	Potential impacts and mitigation measures	Section 4.6.2 Section 4.3.2 Section 4.4.2 Chapter 5.0
4.6.2.1	Greenhouse gases	Section 4.6.2.1
4.7	**Noise and Vibration**	Section 4.7
4.7.1	Description of environmental values	Section 4.7.1 Section 4.2.1
4.7.2	Potential impacts and mitigation measures	Section 4.7.2 Section 4.3 Chapter 5.0

TOR	Heading and description	EIS
4.8	**Ecology**	Section 4.8 Appendix A4.3 Appendix A4.4 Appendix A4.13
4.8.1	Description of environmental values	Section 4.8.1 Section 4.2.1 Section 4.5.1
4.8.2	Potential impacts and mitigation measures	Section 4.8.2 Chapter 5.0
4.9	**Cultural heritage**	Section 4.9 Appendix A4.15
4.9.1	Description of environmental values	Section 4.9.1 Appendix A4.15
4.9.2	Potential impacts and mitigation measures	Section 4.9.2 Appendix A4.15
4.9.2.1	Indigenous cultural heritage	Section 4.9.2.1 Appendix A4.15
4.9.2.2	Non-indigenous historical cultural heritage	Section 4.9.2.2 Appendix A4.15
4.10	**Social values**	Section 4.10 Appendix A4.2
4.10.1	Description of existing social values	Section 4.10.1 Section 5.5.7 Appendix A4.2
4.10.2	Potential impacts and mitigation measures	Section 4.10.2 Chapter 5.0 Appendix A4.2
4.11	**Health and safety**	Section 1.5.1.3 Chapter 4.0 Section 4.10.1.7 Section 4.10.2.8 Section 4.11 Section 4.13.1 Section 4.13.2 Appendix A4.2
4.11.1	Description of values	Chapter 4.0 Section 4.11.1 Section 4.2.1 Section 4.5.1 Section 4.10.1 Appendix A4.2

TOR	Heading and description	EIS
4.11.2	Potential impacts and mitigation measures	Section 4.11.2 Section 4.5.2 Section 4.6.2 Section 4.7.2 Section 4.8.2 Section 4.13.2 Chapter 4.0 Chapter 5.0 Chapter 6.0 Appendix A4.5 Appendix A4.6
4.12	**Economy**	Section 4.12 Appendix A4.1
4.12.1.	Description of potentially affected economies	Section 4.12.1 Chapter 3.0 Appendix A4.1
4.12.2	Potential impacts and mitigation measures	Section 4.12.3 Appendix A4.1
4.13	**Hazard and risk**	Section 4.13 Appendix A4.6
4.13.1	Description of values	Section 4.13.1 Section 4.1.1 Section 4.2.1 Section 4.5.1
4.13.2	Potential impacts and mitigation measures	Section 4.13.2 Chapter 3.0 Table 3-3 Section 4.3.2 Section 4.2.2 Chapter 5.0
4.14	Cross-reference with the terms of reference	Section 4.14
5.0	**Environmental Management Plan**	Chapter 5.0
6.0	**Commitments not included in the Environmental Management Plan**	Chapter 6.0
7.0	**References**	Chapter 9
8.0	**Appendices**	Appendix A1 – A6
A1.	**Final terms of reference for the EIS**	Appendix A1
A2.	**Regulatory approvals**	Appendix A2
A3.	**The standard criteria**	Appendix A3
A4.	**Specialist studies**	Appendix A4.1 to A4.15
A5.	**Research**	Appendix A5
A6	**Study team**	Appendix A6

5. ENVIRONMENTAL MANAGEMENT PLAN

This chapter of the Environmental Impact Statement (EIS) provides an outline Environmental Management Plan (EMP) for the project, which sets out the approach for environmental management in accordance with section 310D of the *Environmental Protection Act 1994* (EP Act). The Plan includes mitigation measures and commitments described in the relevant sections of the EIS to protect the environmental values of the project area.

The EMP is intended to guide the development of detailed management plans and relevant sub-plans to be prepared prior to the project‘s construction and operation.

This chapter has been prepared as a stand-alone document in accordance with the Terms of Reference (TOR) for the EIS without reference to other sections of the EIS.

5.1. PROJECT OVERVIEW

Arrow Bowen Pipeline Pty Ltd[1] (Arrow) intends to construct a 580 km pipeline in Central Queensland comprising the Arrow Bowen (AB) mainline, three lateral pipelines (namely the Elphinstone Lateral (EL), Saraji Lateral (SL) and Dysart Lateral (DL)) and associated infrastructure including above ground facilities, temporary workers‘ accommodation camps and temporary support facilities.

The purpose of the project is to deliver coal seam gas (CSG) from Arrow Energy‘s gas fields in the Bowen Basin (central Queensland) to a proposed Arrow Energy Gladstone Gas Hub (GGH) near Gladstone for further transmission to Arrow Energy‘s proposed Arrow liquid nitrogen gas (LNG) Plant on Curtis Island.

5.1.1. RELEVANT RESOURCE AUTHORITY

The relevant resource authority for constructing and operating the proposed pipeline will be a point-to-point PPL to be issued by DEEDI and an associated EA to be issued by DERM for a Level 1, Chapter 5A Activity and associated Chapter 4 Environmentally Relevant Activities (ERAs).

It should be noted that Arrow has an approved EA (PEN201616610) and a Petroleum Survey Licence (PSL) (PSL 64) for the project from DERM and DEEDI respectively pursuant to Chapter 4, Part 1 of the P&G Act. PSL 64 provides land access, enabling field assessments to be undertaken for ecological and cultural heritage surveys and engineering and construction inspections, particularly to refine pipeline route selection.

[1]The project proponent is Arrow Bowen Pipeline Pty Ltd (Arrow), a wholly-owned subsidiary of Arrow Energy Pty Ltd (Arrow Energy), which is, in turn, a subsidiary of Arrow Energy Holdings Pty Ltd (the Parent Company).

5.1.2. RELEVANT ACTIVITIES

Table 5-1 provides an overview of the environmentally relevant activities likely to be associated with the project and the subject of Arrow's application for a PPL and EA. Further details will be developed and presented in the supplementary EIS.

Table 5-1: Overview of environmentally relevant acticities

ERA and threshold	Description	Aggregate environmental score	Application and assumptions
Schedule 5(5)	Constructing a new pipeline of more than 150 km under a petroleum authority	165	Required for pipeline construction and operation including ancillary activities.
Schedule 5 (8)	A petroleum activity, other than a petroleum activity mentioned in items 1 to 7, that includes a chapter 4 activity for which an aggregate environmental score is stated.	126 (or highest individual score)	Required for pipeline construction and operation including ancillary activities.
14(2)	Electricity generation – consists of generating electricity by using fuel (other than gas) at a rated capacity of 10 MW electrical or more.	76 (10 MW to 150 MW) or 151 (150 MW or more)	Required for temporary workers' accommodation camps. ERA approval will be obtained from DERM under the IDAS pursuant to the SP Act.
15 (1)	Fuel burning – consists of using fuel burning equipment that is capable of burning at least 500 kg of fuel in an hour.	35	Using diesel generators to meet energy requirements for the temporary workers' accommodation camps.
33(1)	Crushing, milling, grinding or screening – consists of crushing, grinding, milling or screening more than 5000 t of material in a year.	N/A	Required for rock crushing and quarry materials for construction of the project.
63(1)(a); (3)(2)(b) – more than 100 to 1500EP	Sewerage treatment – consists of operating 1 or more sewage treatment works at a site, other than no release works, with a total daily peak design of more than 100 to 1500 EP.	53	Required for temporary workers' accommodation camps. ERA approval will be obtained from DERM under the IDAS pursuant to the SP Act.
64 (1)(b); (3)(3)	Water treatment – consists of treating 10 ML or more of raw water in a day.	26	May be required to treat temporary workers' accommodation camp water to meet potable demands.

5.1.3. DESCRIPTION OF THE LAND

The project will commence approximately 90 km north of Moranbah in Central Queensland and terminate at a proposed GGH approximately 22 km southwest of Gladstone where it will join the ASP for further transmission to the proposed Arrow LNG Plant on Curtis Island.

The proposed pipeline route traverses four local government areas (LGAs):

- Whitsunday Regional Council;
- Isaac Regional Council;
- Rockhampton Regional Council; and
- Gladstone Regional Council.

The local context of the proposed pipeline route is described in detail in Section 3.1.2 and is based on information provided within the Arrow Bowen Pipeline – Proposed Pipeline Alignment Travelogue prepared by Coffey, 2011 (Appendix A4.7, Volume 3). Key infrastructure mentioned in this section is illustrated in Map series 8, Volume 2.

Topography along the proposed pipeline route is summarised in **Table 5-2**.

Table 5-2 Topography of the proposed pipeline route

Section of proposed pipeline route	Landform	Elevation (m AHD)	Predominant slope (%)
AB mainline			
AB0 to AB111	Undulating to gently undulating lands, plateau and mesas with steep-scarped dissected margins. High hills or rugged mountains with massive sand-stone outcrops between AB20 to AB39 and AB55 to AB80, south of Glenden.	Between 204 m and 433 m	Slopes generally <3%, up to 6% in creeks and can reach 15% in mountainous area (AB73)
AB111 to AB255	Level alluvial plains subject to flooding particularly along the Isaac River.	Between 94 m and 247 m	Slopes are <1.5%
AB255 to AB305	Strongly undulating to very high hilly and mountainous lands of Mount Gardiner with igneous rock outcrops.	Between 96 m to 191 m	Slopes commonly <5% but slope can reach 15%
AB305 to AB358	Level alluvial floodplain of Fitzroy River to undulating lands, less commonly strongly undulating lands.	Between 24 m to 105 m	Slopes generally <3% but side slopes are up to 12%
AB358 to AB417	Low to steep hilly land from Mount Morgan with some rolling granitic area, rock outcrops and narrow valley plains.	Between 9 m and 100 m	Between 0- 6% but side slopes up to 14%

Section of proposed pipeline route	Landform	Elevation (m AHD)	Predominant slope (%)
AB417 to AB447	Coastal plain at the west of Port Alma and low hills, undulating terrain to flat associated with Fitzroy River and Raglan Creek floodplain.	Between 2.6 m and 53 m	Generally <2% but can reach 3.1%
AB447 to AB477	Low rounded hills to mountainous country around Mount Larcom.	Between 44 m and 102 m	Slopes are typically <6% but side slopes up to 12.2%
Laterals			
EL0 to EL52	Moderately undulating with broad valleys becoming gently undulating or undulating.	Between 242 m and 374 m	Slopes are typically <5% but side slopes up to 7.8%.
SL0 to SL25.8	Gently undulating or level plains.	Between 169 m and 215 m	Slopes are typically <2% with side slopes up to 3.4%.
DL0 to DL25.7	Undulating or gently undulating plains and Level alluvial plains	Between 149 m and 190 m	Slopes are <2.7%

The proposed pipeline route traverses land within seven planning schemes as discussed in **Section 1.5.1.3**) and the relevant development scheme for the SGIC SDA and the GSDA (refer **Section 1.5.1.2**). The majority of land traversed by the proposed pipeline route is included in the rural land use class (96.62%) as outlined in **Table 5-3**.

Table 5-3: Land use classes for land traversed by the proposed pipeline route (%)

Planning scheme / Development Scheme	% of land traversed by the proposed pipeline route intended for rural purpose	% of land traversed by the proposed pipeline route intended for community purpose	% of land traversed by the proposed pipeline route intended for other purpose
Bowen Shire Planning Scheme	1.13%	0%	0%
Nebo Shire Plan	19.25%	0%	0%
Belyando Shire Planning Scheme	2.50%	0%	0%
The Broadsound Plan	31.20%	0%	0%
Livingstone Shire Planning Scheme	9.75%	0%	0%
Fitzroy Planning Scheme	28.01%	0%	1.55% (includes land in the SGIC SDA)
Calliope Shire Planning Scheme	4.79	0.16%	1.67% (includes land in GSDA)
TOTAL	**96.62%**	**0.16%**	**3.21%**

For land included in the GSDA, the applicable land use class as per the development scheme for the GSDA is the ―Materials Transportation and Services Corridor”. The Materials Transportation and Services Corridor Precinct comprises four corridor sub-precincts including Boat Creek Corridor, Western Corridor, Northern Infrastructure Corridor and Curtis Island Corridor.

The predominant existing land uses within the project area are reflective of the current land use classes traversed by the proposed pipeline route and include:

- Agriculture, in particular cropping and grazing;
- Residential dwellings;
- Some community buildings;
- Infrastructure, including roads and railways (refer **Section 4.2.1.6**);
- Coal mines; and
- Conservation areas.

A detailed assessment of the current land uses within a 1 km buffer either side of the proposed pipeline route is outlined in **Section 4.2.1.2 Land Use**.

From AB150 the majority of land within the project area is rural (both freehold and leasehold) and is used for farming enterprises such as broad acre cropping and grazing. Of this cropping and grazing land, the *Soils Assessment* (**Appendix A4.10**, **Volume 3**) identified that:

- Strategic cropping land (SCL) is not traversed by the proposed pipeline route;
- The majority of land traversed by the proposed pipeline route, being 86%, is Class C Good Quality Agricultural Land (GQAL) (refer **Table 4-13** and **Map series 9**, **Volume 2**); and
- The remainder of land traversed by the proposed pipeline route comprises 10.4% Class A GQAL, 3.2% Class B GQAL and 0.2% of Class D GQAL (refer **Table 4-13** and **Map series 9**, **Volume 2**).

5.1.4. ENVIRONMENTAL VALUES

5.1.4.1. Description and potential impacts

The following section provides a summary of the existing environmental values of the land within the project area that may be affected by the project. A detailed description of key environmental values within the project area is provided in Chapter 4 – Environmental Values and Management of Impacts.

SOILS

Soils have been described according to the CSIRO Australian Soils Classification (Isbell, 2002) and a field survey to ground truth the soil classifications was undertaken by SKM between 15 and 23 August 2011. Table

Six major soil orders were found withing the project area (Vertosols, Sodosols Chromosols, Rudosols, Kandosols and Hydrosols). The physical and chemical properties of each soil type identified in **Table 4-15** in terms of their influence over erosion potential, stormwater run-off quality, rehabilitation and agricultural productivity of the land.

The majority of the proposed pipeline traverses land that has a medium potential for erosion. Areas of high hillslope erosion potential (>10t/ha/yr) include the Kerlong Range, Broadsound and Boomer Ranges and Sodosol areas. These areas have a high erosion risk which will lead to increased sedimentation into nearby areas. Additionally the mechanical dispersion of topsoils through machinery movement and the long term exposure of bare soils have the potential to result in increased erosion levels.

No ASS is mapped for the length of the proposed pipeline route (as per current maps published by the Queensland Government National Resources and Water, 2007). However, there may be some soils classed as having a high probability for presence of ASS or potential acid sulphate soils (PASS) in the low lying areas of Bajool - Port Alma area.

CONTAMINATED LAND

The majority of the proposed pipeline route traverses non-industrial land (native vegetation or agricultural land) which is generally not considered to have potential for land contamination. Arrow's land agents interviewed all impacted landholders along the proposed pipeline route gathering information on former land use activities. Several potential notifiable activities (stock dips, landfills, hazardous substance storage) were identified by the landholders as being located on the same lot traversed by the proposed pipeline route but away from the proposed pipeline route and construction area. Additionally, a review of available Google Earth imagery was for the length of the proposed pipeline route identified six possible stockyards and one area of disturbed land (possible landfill) adjacent to the proposed pipeline route (refer **Table 4-18**).

TRANSPORT

The proposed pipeline route crosses several national, regional and district roads controlled by DTMR. These roads are listed in **Table 4-26** which also provides typical nominal volumes expressed in terms of average annual daily traffic (AADT) serviced by various classes of roads. Infrastructure crossings are shown on **Map series 8**, **Volume 2**. Key roads to be crossed and used for access are outlined in Table 5-4.

Table 5-4: Key roads to be crossed and used for access

Road ID	Road name	Classification
10E	Bruce Highway (Benaraby-Rockhampton)	National Highway
41E	Burnett Highway (Biloela-Mount Morgan)	State Strategic Road
16A	Capricorn Highway (Rockhampton-Duaringa)	State Strategic Road
5101	Duaringa-Apis Creek Road	District Road
85C	Fitzroy Development Road (Dingo-Mt Flora)	Regional Road
33A	Peak Downs Road (Nebo-Mackay)	State Strategic Road
33A	Peak Downs (Clermonth to Nebo)	State Strategic Road
82A	Suttor Development Road (Nebo-Mt Coolan)	Regional Road

A total of five railway lines will be crossed by the proposed pipeline route as identified in **Section 3.4.1.4**.

It is anticipated that project construction will occur over a period of approximately 15 months with haulage of materials and plant will be a seven-day-per-week operation. The duration of construction activity at any location along the proposed pipeline route will depend on the terrain and other factors, but will be a number of weeks, rather than months. A description of the expected construction traffic to be generated is provided in Section 4.3.1.5.

The assessment of road transport impacts has identified that:

- Construction traffic will create short term increases in traffic volumes on the road network during the construction period of 15 months;
- The worse-case increase in traffic on key SCRs from the construction of the pipeline is considered moderate in terms of congestion and roadway capacity;
- The key SCRs have sufficient spare roadway capacity to accommodate the expected traffic increases during the construction period and will operate at acceptable levels of service (i.e. LOS C or better);

- The delivery of materials and equipment will be spread over the construction period of 15 months and the movement of these vehicles can be arranged to minimise impacts on the local community;
- Construction activity will primarily be confined within the ROW, and traffic movements will be managed by appropriate traffic control plans for work sites;
- The operation of the pipeline will not generate additional traffic except for inspection and maintenance vehicles, the incidence of which will be negligible; and
- The current road network has been identified to be suitable for the proposed vehicle movements without the need for major improvements to pavement condition, carriageway alignment and road width based on this desktop assessment.

WASTE

Waste will be generated throughout all phases of the project, including construction, operation and decommissioning and will include air emissions, excavated waste, solid and liquid waste. The largest quantities of waste will occur during the construction of the proposed pipeline. Construction waste will be generated along the ROW, at laydown areas within the ROW and at temporary workers‘ accommodation camps. Small amounts of waste will be produced during operation and maintenance in the form of liquid waste from the pigging and pipe cleaning activities. It is predicted that small volumes of scrap metal will be generated when the proposed pipeline is eventually decommissioned.

The waste items, volumes and existing environmental values which will potentially be impacted by the generation of waste are described in **Table 4-41**.

The potential impacts associated the unregulated/uncontrolled storage and disposal of waste includes:

- Potential nuisance to local residences from dust deposition during the excavation of the trench, the storage and treatment of spoil and topsoil and the movement of vehicles and equipment along the ROW and road network;
- Potential contamination of existing land-uses and soil resulting in a loss or deterioration of GQAL and SCL;
- Potential contamination of existing water resources and water quality from the accidental spillage or leakage of hazardous chemicals and substances;
- Potential contamination of protected ecosystems and habitats resulting in their deterioration or loss; and

- Potential impacts on the community's health and safety and quality of life from the loss or deterioration of the recreational and visual amenity and the landscape character of the project area.

The storage and disposal of waste generated during the construction, operation and decommissioning of the project is unlikely to have significant impacts. Waste management will be an integral component of all phases of the project, particularly during construction. A WMP will be prepared prior to the commencement of the construction in accordance with the EPP (Waste) and all applicable legislative requirements.

WATER

The proposed pipeline route will cross a number of perennial, seasonal and intermittent watercourses including rivers, streams, floodplains and wetlands as shown on **Map series 8**, **Volume 2**.

A total of 54 watercourses were assessed along the proposed pipeline route. Many of the watercourses anticipated to be traversed by the proposed pipeline route are typical of Australian inland waters, being intermittent with little to no flow during the drier months. Based on an assessment of DERM's database for the minimum and maximum mean monthly flows, it has been determined that most watercourses traversed by the proposed pipeline route have maximum flows in January and February, with the lowest flows in August and September. The Fitzroy River is the largest river system crossed by the proposed pipeline route with a 50 m wide flowing channel at the crossing point (AB319.5). Other significant crossings include the seasonal Isaac River (AB234) and Raglan Creek (AB446.6).

Water is required for a number of aspects of the project including potable water for workers camps, non-potable water for construction activities and hydrostatic pressure testing.

There are a wide range of water users within the Burdekin, Fitzroy and Calliope river basins with end use varying from stock and domestic agricultural, industrial and mining, and domestic water supply. The *Water Availability Study* (**Appendix A4.9**, **Volume 3**) identified adequate water resources distributed along the proposed pipeline route. The study also identified available water supply sources and the entities responsible for them.

A flood assessment has also considered locations where significant lengths of the proposed pipeline route would be inundated during a 100 year ARI event. The low lying areas identified in the location analysis as prone to flooding may require buoyancy control measures. These measures will include extra depth (1,200 min. depth of cover), concrete coating of the pipeline, set on weights, or other buoyancy control measures (or a combination thereof) to ensure that the pipe is negatively buoyant. Potentially flooded areas will be further investigated and considered in the detailed design. Operation of the pipeline is not expected to be impacted by flooding.

AIR QUALITY

The existing air quality along the proposed pipeline route is influenced by local and regional sources including:

- Coal mines;
- Windblown dust from exposed agricultural land and unsealed roads;
- Dust storms and bushfires (agricultural burning);
- Motor vehicle emissions from local, regional and state highways along the pipeline; and
- Industrial sources around Rockhampton and Gladstone.

A total of 119 residential dwellings have been identified within a 1 km buffer either side of the proposed pipeline route. Only two houses are located within 100 m of the ROW at AB398 (approximately 77 m from the proposed pipeline route) and AB440 (approximately 92 m from the proposed pipeline route).

The main types of air emissions associated with the project are from particulate matter (dust) and to a lesser extent the combustion products of construction vehicles. The exhaust emissions include combustion products such as carbon monoxide (CO), nitrogen dioxide (NO_2) and PM_{10}. Due to the nature of the project, both in terms of vehicles used and a non-static construction site, these emissions are extremely low and are not considered to be a significant impact. There will be no sources of odour during the construction of the pipeline.

The construction of the project is estimated to result in approximately 53,601 t CO_2-e of greenhouse gases representing 26,801 t CO_2-e on an annual basis. The annual emissions represent a small fraction of Queensland's (0.02%) and Australia's (0.005%) annual greenhouse gas emissions of 155.1 Mt CO_2-e (DCCEE 2010) and 564.4 Mt CO_2-e (DCCEE 2010) for the 2009 reporting year.

It is considered unlikely that the project will result in exceedances of the EPP(Air) guidelines if appropriate mitigation measures are implemented throughout the construction period.

Greenhouse gas emissions from construction and operation of the project represent a small fraction of Queensland greenhouse gas emissions.

NOISE AND VIBRATION

Major existing noise sources along the proposed pipeline route consist of the Main North Coast Railway Line and the Bruce Highway. Other typical rural noise sources include occasional light aircraft, tractors and light vehicles. Several mining tenements including Xstrata Coal Queensland Pty Ltd, Peabody (Burton Coal) Pty Ltd, Vale Australia Pty Ltd, Coppabella Coal Pty Ltd, Marlborough Nickel Pty Ltd and Cement Australia are located within 200 m of the proposed pipeline route. In some areas along the proposed pipeline route, mining activities are audible at the sensitive receptors.

Vibration sources including roads, railway line and mining activities identified along the proposed pipeline route are not likely to cause perceivable vibration levels at the sensitive receptors therefore no baseline vibration monitoring was carried out for the project.

During construction, the key activities with potential to generate noise include:

- Clear and grade.
- Stringing and welding.
- Trenching.
- Lowering-in and backfilling.
- HDD.
- Clean-up, restoration and rehabilitation.

Noise levels from construction of the pipeline are estimated at sensitive receptors based on the construction information and the approximate sound power levels for this equipment (measured at the noise source), as specified in **Table 4-61**.

Construction noise impacts of the proposed pipeline route are expected to exceed the project goal at approximately seven noise sensitive receptors (within 200 m) but the impact is likely to be minimal considering activity will only occur during the day for the majority of the works and will be short term at any one location.

ECOLOGY

The *Environmental Assessment Report (Flora) for the Proposed Arrow Bowen Pipeline* is presented in **Appendix A4.3**, **Volume 3,** the *Terrestrial Fauna Assessment* is presented in **Appendix A4.4**, **Volume 3** and the *Aquatic Ecology Assessment* is presented in **Appendix A4.13**, **Volume 3**.

Based on desktop and field assessments of terrestrial flora values within the project area, the proposed pipeline route is characterised by:

- Non-remnant vegetation (428.79 km or 73.8% of the proposed pipeline route), most of which is cropping and grazing land;
- High value regrowth (28.06 km or 4.78%); and

- Remnant vegetation (124.03 km or 21.4%) comprising of Endangered Regional Ecosystems (REs) (0.44 km or 0.07% of the route), Of Concern REs (27.8 km or 4.79% of the route) and No Concern at Present REs (95.7 km or 16.4% of the route).

Without mitigation measures being applied, the total disturbance area would be a maximum of 371.2 ha of remnant vegetation (456.29 ha including high value regrowth) assuming that the entire 580 km by 30 m ROW is cleared.

The key flora values potentially affected by the project include:

- Loss of Endangered brigalow communities
- Loss of Endangered Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin;
- Loss of 12 Of Concern REs (a maximum of 83.5 ha (or 0.15% of the 5 km buffer) would be impacted by the 30 m pipeline route;
- Loss of 16 No Concern at Present REs (a maximum of 287.21 ha (or 0.22% of the 5 km buffer) would be impacted by the 30 m ROW.
- Impacts on four Endangered, Vulnerable and Near Threatened (EVNT) flora species recorded in or close to the proposed pipeline route during the field surveys;
- Loss of potential habitat for EVNT flora species;
- Loss of freshwater wetland ecosystems and associated riparian vegetation;
- Loss of marine wetlands and associated marine plants; and
- Fragmentation of remnant vegetation blocks.

While all practicable efforts will be made to avoid and minimise impacts on flora of high ecological value through on-going minor route refinements, it is likely that small areas will be cleared or disturbed for construction and thus operation of the pipeline. Where residual impacts cannot be avoided, an offset plan will be prepared and implemented to rehabilitate vegetation similar to that of the impacted vegetation in a nearby location.

An expanded project area of 20 km buffer to the ROW was utilised to capture sufficient fauna data during desktop assessment. Winter and spring field surveys were conducted to account for different seasonal conditions.

The key fauna issues potentially affected by the project include:

- Disturbance to mature vegetation and hollow-bearing trees and therefore loss of perching, foraging and nesting resources;

- Potential disturbance to fauna movement corridors and dry season fauna refuges (predominantly associated with creeks and dams). Such impacts are primarily temporary in nature;
- A temporary barrier to fauna movement and potential ‗trap' provided by the open pipeline trench (trenchfall);
- Potential limited disturbance to Brigalow communities which provide habitat for the Vulnerable Ornamental Snake;
- Potential impacts on several EVNT fauna species recorded in or close to the proposed alignment during the field surveys, including the Powerful Owl, Grey Goshawk and Grey Snake;
- Disturbance to potential habitat for EVNT fauna species including the Yellow Chat, Powerful Owl, Grey Snake, Ornamental Snake, Brigalow Scaly-foot, Yakka Skink, Common Death Adder, Little Pied Bat and Grey-headed Flying Fox;
- Limited disturbance to riparian vegetation and associated wetland ecosystems providing restricted habitat types for a range of least concern fauna species; and
- Fragmentation of remnant vegetation blocks, particularly in association with hills and ranges north of Moranbah.

The proposed pipeline route transects 350 m of saltmarsh and mangrove communities, which contain marine plants and bare marine substrate. Assuming that the entire 30 m ROW contains marine vegetation and/or habitat and requires removal for construction, the maximum total disturbance area would be approximately 1.05 ha. The proposed pipeline route will potentially impact riparian plant species and aquatic plant species associated with watercourses and natural waterholes / wetland areas. Potential impacts to aquatic flora and fauna are likely to occur from trenching and include direct loss of marine plants, loss of marine habitat, changes in hydrology and fish passage, transport of sediment and other pollutants and aquatic weed invasion.

Appropriate mitigation measures will be implemented, including the minor realignment of the proposed pipeline route during detailed design, to avoid or minimise clearing of areas of high environmental value. An offset strategy will be developed to compensate for any residual impacts on important ecological values (e.g. EECs, Endangered and Of Concern REs, habitat for EVNT species, wetlands) (refer to **Appendix A4.3**, **Volume 3**).

CULTURAL HERITAGE

A native title and cultural heritage compliance strategy has been initiated by Arrow to voluntarily resolve native title interests. Over 200 km of the project is subject to authorised ILUAs with relevant registered native title parties. The remaining areas are subject to active ILUA negotiations.

No places within a 1 km buffer either side of the proposed pipeline route were identified from a review of Commonwealth heritage lists and registers. However, a search of the ICHRD returned 75 entries that are located within a 1 km buffer of the proposed pipeline route

The development of a CHMP or a suitable native title agreement that does not expressly exclude cultural heritage, such as an ILUA, in consultation with Aboriginal Parties will ensure the protection and management of cultural areas, object and values identified during cultural heritage surveys with the involvement of Aboriginal parties.

Arrow Energy will seek to develop an approved CHMP or a native title agreement that addresses Aboriginal cultural heritage in consultation with the endorsed Aboriginal parties for the project. Compliance with the approved CHMP or native title agreement that addresses Aboriginal cultural heritage will constitute Arrow Energy‘s compliance with the Aboriginal Cultural Heritage Act duty of care.

The results of the desktop analysis found no sites listed on the Commonwealth heritage lists or registers within the project area. One site listed on the QHR is located outside the project area and will not be impacted.

To mitigate potential impacts on historic heritage values, a draft HHMP has been developed and will be implemented as part of the project EMP. With the implementation of appropriate mitigation, it is anticipated that the residual impacts on non-Indigenous cultural heritage will be minor and manageable.

SOCIAL IMPACTS

Accommodation for the construction workers will be in temporary workers‘ accommodation camps near the ROW. In addition, there may be requirements for small specialist work crews (poor boy crews) which may require accommodation for a few weeks in a local motel. Temporary workers‘ accommodation camps will also be provided with a range of services and facilities to cater for the day-to-day needs of workers, including sleeping areas, showers and toilets, laundry, rest and recreation area, kitchen/dining areas and first aid facilities.

Some local workers will be required for unskilled jobs such as fuel suppliers and fencing contractors. The use of temporary workers‘ accommodation camps and a FIFO workforce will not impact on housing prices or rental prices in the existing townships. Employment opportunities for Indigenous people with suitable training will be explored for a number of supporting roles, including rehabilitation.

Demand on local hospital based services are not anticipated as the temporary workers' accommodation camps have a nurse and/or paramedic who can attend most cases. In the instance of major trauma cases workers will be transported to a major regional health facility for specialist care. In rare instances, there may be a minor short term impact on GP services in the projects area when a paramedic is unable to treat a worker and the case is not suitable for transportation to a major regional hospital. Identification of GP services that have the capacity will be provided to workers to ensure GPs are still able to service the local community.

Social impacts associated with the project have been assessed for all stages of the project including the construction, operation and decommissioning. Overall, the project is expected to provide minor benefits to local and regional communities through direct and indirect employment opportunities. However, the project is likely to have some minor impacts for communities closest to the proposed pipeline route, due to temporary disruption to land uses during construction and changes to local traffic and access.

ECONOMY

Economic impacts associated with the project have been assessed for all stages of the project including, construction, commissioning, operation, and decommissioning. Overall, the project is estimated to contribute significant economic gains to the project area and the domestic economy.

This is especially during construction, by generating an estimated total output impact of $2.9 billion, as well as supporting an estimated annual average of 2,952 FTE jobs during construction, 28 FTE jobs during operation, and contributing $627 million in household income over the life of the project. The project is aligned with local government policies and aspirations, supporting and strengthening the Australian economy.

Specifically, the project is expected to provide a number of economic benefits to the project area and well as Queensland and Australia including:

- Contribution to output;
- Contribution to household income;
- Contribution to employment; and
- An indirect contribution to energy self sufficiency and security of supply, and the continued prosperity of the Australian economy.

While some economic risks have been identified in the project area, they are generally low and cumulative impacts associated with significant projects in the project area are negligible.

HEALTH AND SAFETY

The health and safety of the community will be given high priority during all phases of the project, from design to construction and operation and finally through to its eventual decommissioning.

Arrow Energy maintains an *Environmental, Health and Safety Management System* which provides a framework for continually improving the management system and management practices that minimise any adverse environmental, health and safety impacts arising from the project. To manage day-to-day medical treatment requirements, a first aid facility with an on-site nurse or paramedic will be provided at the temporary workers' accommodation camps. Agreements will be established with local health districts for nurses or medical professionals to visit camps if required. Hospitals, health care and GP services will be notified as the project progresses in the event that their services will be required. The procedures for emergency evacuation will also be outlined in an ERP.

HAZARD AND RISK

The preliminary hazard identification and risk assessment conducted for the project shows that the residual risks for the project are insignificant and minor. No moderate, major or catastrophic residual risks have been identified.

The majority of the hazards and risks identified are related to typical linear infrastructure construction activities which will be effectively mitigated. The key hazards and risks during operation will be managed by a comprehensive operations and maintenance program. Adherence to relevant legislation, policies, guidelines and standards for pipeline construction and operation will ensure that the probability of an incident is low.

Natural hazard management areas have been identified for flood, bushfires and landslide and measures proposed to mitigate the potential adverse effects from such events, to meet with the requirements of SPP/1/03. Future geotechnical investigations will be conducted prior to construction to minimise potential risks from seismic hazards.

Consequently, the objectives relating to minimising hazards and risks on people and property will be met during all project phases.

5.2. REHABILITATION PROGRAM

The proposed cleanup and rehabilitation objectives and performance criteria for land are presented in Table 5.5.6. The rehabilitation program will be presented in the supplementary EIS.

5.2.1. FINANCIAL ASSURANCE

The proposed amount of financial assurance for the environmental authority will be presented in the supplementary EIS.

5.3. LEGISLATIVE AND OTHER CONSIDERATIONS

Applicable legislation, policies, guidelines and associated standards relevant to the project and environmental protection are described in this section. The delivery and implementation of the project must achieve the performance objectives established in the EMP.

The EMP incorporates the relevant requirements of the Australian Pipeline Industry Association (APIA) Code.

5.3.1. ENVIRONMENTAL PROTECTION ACT 1994

The EP Act is the overarching legislation for the regulatory management of the environment in Queensland. The EP Act is based on self-regulation and a duty of care, which places the responsibility for protection of the environment on all involved persons during the conduct of all activities.

The EP Act provides for the granting of Environmental Approvals (EAs) and Environmentally Relevant Activities (ERAs). It is noted that approval for ERAs (e.g. for the temporary workers' accommodation camps) will be sought separately to the EIS process under the Integrated Development Assessment System (IDAS) pursuant to the *Sustainable Planning Act 2009* (SP Act). The EP Act also provides the power for administering authorities to order actions to be taken to improve environmental performance, conduct audits and environmental evaluations of activities, approve environmental management programs and impose penalties or prosecute persons for non-compliance within the requirements of the Act.

The EP Act also allows for the preparation of Environmental Protection Policies (EPPs). The following EPPs being applicable to the project:

- EPP (Water);
- EPP (Noise);
- EPP (Air); and
- EPP (Waste Management).

Each of these policies identifies the environmental values and performance objectives required to protect these values and have been incorporated within this EMP.

Refer to **Section 1.5.1.2** of the EIS.

All legislation, policies, guidelines and standards applicable to the relevant sections of the EIS are summarised in **Table 5-5**. They will apply to monitoring and auditing of performance of the project. The construction contractor will be responsible for retaining copies of the listed legislation, guidelines and standards at each worksite.

Table 5-5: Environmental legislation, policies, guidelines and standards

Element	Legislation, policies, guidelines
Climate	▪ *National Climate Change Adaption Framework;* ▪ *State Planning Policy* (SPP) *1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide;* ▪ *ClimateQ: toward a greener Queensland;* ▪ *AS/NZS 1170.2:2011 Structural Design Actions – Part 2: Wind Actions;* ▪ *AS 1170.4:2007 Structural Design Actions – Part 4: Earthquake Actions in Australia; and* ▪ *AS 3959-2009 Construction of buildings in bushfire-prone areas.*
Land	▪ *Coastal Protection and Management Act 1995;* ▪ *Environmental Protection Act 1994;* ▪ *Environmental Protection Regulation 2008;* ▪ *State Development and Public Works Organisation Act 1971;* ▪ *Sustainable Planning Act 2009;* ▪ *Sustainable Planning Regulation 2009;* ▪ *Central Queensland Regional Plan;* ▪ *Curtis Coastal Regional Coastal Management Plan;* ▪ *Mackay, Isaac, Whitsunday Regional Plan;* ▪ *SPP 1/92 Development and Conservation of Agricultural Land;* ▪ *SPP 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide;* ▪ *SPP 2/02 Planning and Managing Development Involving Acid Sulphate Soils;* ▪ *Strategic Cropping Land Act 2011;* ▪ *National Environment Protection (Assessment of Site Contamination) Measure 1999;* ▪ *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998.*
Transport	▪ *Environmental Protection (Waste Management) Policy 2000;* ▪ *Transport Infrastructure Act 1994*; ▪ *Transport Infrastructure (State-controlled Roads) Regulation 2006;* ▪ *Transport Planning and Co-ordination Act 1994;* ▪ *Transport Co-ordination Plan for Queensland 2008-2018;* ▪ *Transport Operations (Road Use Management) Act 1995;* and ▪ *Integrated Transport Planning Framework.*
Waste	▪ *Environmental Protection Act 1994;* ▪ *Environmental Protection Regulation 2008;* ▪ *Environmental Protection (Waste Management) Regulation 2000;* ▪ *Environmental Protection (Waste Management) Policy 2000;* ▪ *Environmental Protection (Air) Policy 2008 (EPP (Air));* ▪ *Queensland's Waste Reduction and Recycling Strategy 2010-2020;* and ▪ *Central Queensland Waste Management Strategy.*

Element	Legislation, policies, guidelines
Water	▪ *Environmental Protection Act 1994;* ▪ *Environmental Protection (Water) Policy 2009;* ▪ *Water Act 2000;* ▪ *Water Resource (Burdekin Basin) Plan 2007* and associated Resource Operations Plan (ROP); ▪ *Water Resource (Fitzroy Basin) Plan 1999* and associated ROP*;* ▪ *Water Resource (Calliope River Basin) Plan 2006* and associated ROP; ▪ *Code of Environmental Practice – Onshore* Pipelines (APIA CoEP, 2009); ▪ *Establishing Environmental Values, Water Quality Guidelines and Water Quality Objectives for Fitzroy Basin Waters – Draft for Consultation* (Department of Environment and Resource Management (DERM), 2010); ▪ *Guideline - Establishing Draft Environmental Values, Management Goals and Water Quality Objectives* (DERM, 2011); ▪ *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC & ARMCANZ, 2000); and ▪ *Queensland Water Quality Guidelines 2009* (DERM, 2009).
Air	▪ *Environmental Protection Act 1994;* ▪ *National Greenhouse and Energy Reporting Act 2007;* ▪ *The National Greenhouse Accounts (NGA) Factors 2011*; and ▪ *Queensland Environment Protection (Air) Policy 2008*.
Noise and vibration	▪ *Environmental Protection Act 1994;* ▪ *Environmental Protection (Noise) Policy 2008;* ▪ *Ecoaccess guideline, Noise and Vibration from Blasting* (DERM, 2006); ▪ *Australian Standard (AS) 2436:1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;* ▪ *British Standard BS6472-1992 - Evaluation of Human Exposure to Vibration in Buildings;* and ▪ *British Standard BS 7385-1993 - Assessing the effects of vibration on structures.*
Ecology	▪ *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth); ▪ *Fisheries Act 1994;* ▪ *Land Protection (Pest and Stock Route Management) Act 2002;* ▪ *Nature Conservation Act 1992; and* ▪ *Vegetation Management Act 1999.*
Cultural heritage	▪ *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth);* ▪ *Australian Heritage Council Act 2003 (Commonwealth);* ▪ *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth);* ▪ *Native Title Act 1993 (Commonwealth);* ▪ *Queensland Heritage Act 1992;* ▪ *Aboriginal Cultural Heritage Act 2003;* and ▪ *Curtis Coast Regional Coastal Management Plan.*

Element	Legislation, policies, guidelines
Social	▪ *Central Queensland Regional Framework for Growth Management(RFGM) (2002);* ▪ *Central Queensland Regional Framework for Growth Management (RFGM) (2002);* ▪ *Central Queensland Regional Plan;* ▪ *Draft Mackay, Isaac, Whitsunday Regional Plan;* and ▪ *Mackay, Isaac and Whitsunday Regional Plan 2011;* and ▪ *Sustainable Resource Communities Policy 2008.*
Health and safety	▪ *Building Act 1975;* ▪ *Building Fire and Safety Regulation 1991;* ▪ *Explosives Act 1999;* ▪ *Explosives Regulation 2003;* ▪ *Fire and Rescue Service Act 1990;* ▪ *Fire and Rescue Service Regulation 2001;* ▪ *Health Act 1937;* ▪ *Health Regulations 1996;* ▪ *Health (Drugs and Poisons) Regulations 1996;* ▪ *Petroleum and Gas (Production and Safety) Act 2004;* ▪ *Radiation Safety Act 1999;* ▪ *Radiation Safety Regulation 1999;* ▪ *Transport Operations (Road Use Management) Act 1995;* ▪ *Workplace Health and Safety Act 1995;* ▪ *Workplace Health and Safety Regulation 2008;* ▪ *AS2885: Pipelines – Gas and Liquid Petroleum;* ▪ *AS2885.1-2007: Pipelines – Gas and Liquid Petroleum – Design and Construction;* ▪ *AS 1170.4:2007: Structural design actions - Earthquake actions in Australia;* ▪ *AS 1210:1997: Pressure vessels;* ▪ *AS 1768:2007: Lightning protection;* ▪ *AS 1885.1:1990: Workplace injury and disease recording standard in the workplace;* ▪ *AS 1940-2004: The storage and handling of flammable and combustible liquids;* ▪ *AS 2865:1995: Safe Working in a Confined Space (NOHSC:1009(1994));* ▪ *AS 2958: Earth-moving machinery – Safety;* ▪ *AS 3780-2008: The storage and handling of corrosive substances;* ▪ *AS 3814-2009: Industrial and commercial gas-fired appliances;* ▪ *AS 4024: Safety of machinery;* ▪ *AS ISO 31000:2009: Risk management, principles and guidelines;* ▪ *AS 4801:2001: Occupational health and safety management systems - Specification with guidance for use;* ▪ *AS 60079.10.1:2009: Explosive atmospheres - Classification of areas - Explosive gas; atmospheres (IEC 60079-10-1, Ed.1.0(2008) MOD);* ▪ *AS IEC61511:2004: Functional Safety – Safety instrumented systems for the process industry sector;* ▪ *National Standard for Construction Work [NOHSC: 1016 (2005)];*

Element	Legislation, policies, guidelines
	▪ *National Standard for Manual Tasks (2007);* ▪ *National Standard for Occupational Noise [NOHSC: 1007 (2000)];* ▪ *National Standard for Plant [NOHSC: 1010 (1994)];* ▪ *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC: 1003 (1995)];* ▪ *Australian Code for the Transport of Dangerous Goods by Road and Rail, 7th Edition;* ▪ *Australian Code for the Transport of Explosives by Road and Rail, 3rd Edition;* ▪ *National Code of Practice for the Control of Workplace Hazardous Substances [NOHSC: 2007 (1994)];* ▪ *National Code Of Practice for Induction for Construction Work, May 2007;* ▪ *National Code of Practice for the Prevention of Falls in General Construction, April 2008;* ▪ *The National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007);* ▪ *National Code of Practice for the Prevention of Occupational Overuse Syndrome [NOHSC:2013(1994)];* ▪ *Hazardous Substances Code of Practice: 2003;* ▪ *Mobile Crane Code of Practice 2006;* ▪ *Plant Code of Practice 2005;* ▪ *Risk Management Code of Practice 2007;* ▪ *Traffic Management for Construction or Maintenance Work Code of Practice 2008;* ▪ *AS ISO 14001:2004(b): Environmental Management Systems (EMS) – Requirements with guidance for use;* ▪ *AS ISO 14004:2004(c): EMS – General guidelines on principles, systems and supporting techniques;* ▪ *AS 4801:2001 Occupational health and safety management systems – Specification with guidance for use;* and ▪ *AS 4804:2001(a): Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques.*
Hazard and risk	▪ *Dangerous Goods Safety Management Act 2001;* ▪ *Land Protection (Pest and Stock Route Management) Act 2002;* ▪ *Workplace Health and Safety Act 1995;* ▪ *State Planning Policy (SPP) 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide;* ▪ *Guidelines for the Preparation of a Transport Emergency Response Plan;* ▪ *AS 2885.1 2007: Pipelines - Gas and Liquid Petroleum;* ▪ *AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines;* ▪ *AS 1216 – 2006: Classification, Hazard identification and Information Systems for Dangerous Goods;* ▪ *AS 1940 – 2004: Storage and Handling of Flammable and Combustible Liquids;* ▪ *AS 3780 – 2008: The Storage and Handling of Corrosive Substances;*

Element	Legislation, policies, guidelines
	▪ *AS 2809 – 2008: Road Tank Vehicles for Dangerous Goods;* and ▪ *AS 2931– 1999: Selection of Use of Emergency Procedure Guides for Transport of Dangerous Goods.*

5.4. ENVIRONMENTAL MANAGEMENT PLAN ELEMENTS

Environmental Management Plan (EMP) elements are described in **Section 5.5** and specific management strategies are described in **Section 5.6** and **Section 5.7**.

Management strategies are organised by environmental aspect, in general accordance with the APIA Code. Environmental aspects relevant to the construction of the pipeline also reflect the typical structure of EAs as issued by DERM.

An outline of how each EMP is to be developed is shown in **Table 5-6**: EMP structure of each element

EMP component	Description
Element / Issue	Aspect of construction or operation to be managed (as it affects environmental values)
Performance Objectives	The management objective / target that is intended to be achieved for each element.
Performance Criteria	Measureable indicators / criteria by which to assess performance / level of achievement of management strategies against the stated performance objectives.
Implementation / Management Strategies	Targeted strategies, tasks or action programs that will be implemented to achieve the performance criteria.
Monitoring	The mechanisms by which actual performance effectiveness of the management strategies will be monitored.
Auditing	The auditing requirements to demonstrate implementation of construction, operation and decommissioning / rehabilitation management strategies and compliance with stated performance criteria.
Reporting	Details of how and when results of monitoring and any necessary corrective actions are reported internally and to the responsible authorities.
Corrective Action	Detail of action to be taken as soon as monitoring results indicate a potential or actual breach of the performance criteria.
Responsible Persons	Key project personnel responsible for implementing the Management Strategies (chief responsibility listed first).
Associated Documentation	Documentation which relates to, and may assist with, meeting the performance objectives.

.

Table 5-6: EMP structure of each element

EMP component	Description
Element / Issue	Aspect of construction or operation to be managed (as it affects environmental values)
Performance Objectives	The management objective / target that is intended to be achieved for each element.
Performance Criteria	Measureable indicators / criteria by which to assess performance / level of achievement of management strategies against the stated performance objectives.
Implementation / Management Strategies	Targeted strategies, tasks or action programs that will be implemented to achieve the performance criteria.
Monitoring	The mechanisms by which actual performance effectiveness of the management strategies will be monitored.
Auditing	The auditing requirements to demonstrate implementation of construction, operation and decommissioning / rehabilitation management strategies and compliance with stated performance criteria.
Reporting	Details of how and when results of monitoring and any necessary corrective actions are reported internally and to the responsible authorities.
Corrective Action	Detail of action to be taken as soon as monitoring results indicate a potential or actual breach of the performance criteria.
Responsible Persons	Key project personnel responsible for implementing the Management Strategies (chief responsibility listed first).
Associated Documentation	Documentation which relates to, and may assist with, meeting the performance objectives.

5.5. ENVIRONMENTAL MANAGEMENT SYSTEM

The construction contractor will be required to develop and implement an Environmental Management System (EMS) (to the requirements of IS014001) aligned with Arrow Energy's EMS and project-specific Standard Operating Procedures (SOPs) to proactively manage the environment, ensure compliance with all legislative requirements (including compliance with all requirements outlined in this EMP) and to ensure a process of continuous improvement for all matters pertaining to the project.

Proposed SOPs include:

- Air Emissions Procedure
- Competence - Environmental Aspects Procedure
- Cultural Heritage Procedure
- Environmental Alert Procedure
- Environmental Corrective Actions Procedure

- Environmental Incident Reporting Investigation and Remediation Procedure
- Environmental Noise and Vibration Management Procedure
- Environmental Regulatory Compliance Procedure
- Erosion Controls and Rehabilitation
- Land Clearing and Ground Disturbance
- Rehabilitation Procedure
- Traffic and Transport - Environmental Aspects Procedure
- Visual and Landscape Procedure
- Waste Management Procedure
- Water Management Procedure
- Weed and Pathogen Management Procedure
- Wildlife and Stock Management.

5.5.1. KEY RESPONSIBILITIES

A rigorous approach to environmental management is required to deliver the project with the least possible impact on communities and local businesses and the least delay to the construction phase. A clear implementation and management structure is required to achieve sound environmental management.

All staff and contractors of Arrow Energy have a general environmental duty under section 319 of the EP Act and must not carry out any activities that cause, or are likely to cause, environmental harm, unless all reasonable and practical measures are taken to prevent or minimise harm. If in the performance of their work, project staff notice that serious or material environmental harm is being caused or threatened by their actions or the actions of someone else, they must report the matter under the Act. Additionally, project staff will be required to comply with the following items at all times:

- The project specific EMS;
- Relevant legislation, with particular attention to environmental legislation under this outline EMP;
- EMP requirements, including relevant criteria for design, construction and operation; and
- Training requirements.

The key responsibilities are described as follows.

5.5.1.1. Construction Manager

The project Construction Manager will direct work in a manner that complies with all relevant environmental procedures, adheres to all legislative requirements, and ensures that the requirements of the EMP and the EA are implemented. The Construction Manager has ‗stop task‘ and ‗stop work‘ authority.

5.5.1.2. Environmental Officer

The Environmental Officer is responsible for monitoring and reporting the implementation of the construction EMP as well as other key environmental construction documentation (e.g. procedures and management plans). The Environmental Officer will also be responsible for implementation of the CHMP, Complaints Register and for setting up compliance audits and monitoring programs. Construction compliance auditing of environmental aspects of the project will be conducted against the requirements of the EMP, the Construction Safe Work Method Statements, Licence and Permit Conditions.

5.5.2. TRAINING

The success of the EMP depends on all those responsible for implementation and review being thoroughly conversant with its contents, interpretation and performance measurements. Arrow and its contractors will be responsible for ensuring that project personnel have sufficient knowledge and awareness to identify potential environmental issues, and that they are trained to take appropriate corrective action.

It is essential that all personnel are familiar with the procedures for reporting on issues that may result in environmental degradation. This includes informing key personnel within Arrow and relevant regulatory authorities in accordance with an authorisation matrix which will be determined for the project prior to the commencement of construction.

5.5.3. INDUCTION

All staff, including construction and field staff, will complete a comprehensive project induction prior to commencing work on the project. The induction will include safety, access and a comprehensive review of environmental requirements (including nature conservation protection measures, soil management, waterway protection, cultural heritage management and weed control). All project personnel from supervisory to managerial level will have an additional detailed training session on the use and implementation of the EMP. It is the responsibility of the Construction Manager to ensure records of training are maintained.

5.5.4. TOOLBOX MEETINGS

The Construction Manager will ensure that supervisors hold weekly toolbox talks with staff and crews to discuss issues associated with the scheduled work.

This will include highlighting and discussing relevant environmental and safety issues as required. The sessions will include discussion of strategies to be implemented as identified in Job Hazard Analysis (JHA) of current work activities. A construction OH&S Plan will be prepared by the construction contractor.

5.5.5. JOB HAZARD ANALYSIS

Safe Work Method Statements (SWMS) will be used to record procedures for all daily activities. All SWMSs will contain a Job Hazard Analysis (JHA). Prior to any new work commencing, an SWMS, including a JHA, will be prepared and approved.

A JHA is a simple tool that is used in helping personnel identify, analyse and manage the hazards that exist in the work they undertake. It formalises the process of hazard identification and risk management that most people follow when working. The JHA requires personnel to examine the task they are about to undertake and:

- Break the job down into separate, defined steps;
- For each step identify the potential hazards (including potential environmental or cultural heritage hazards) that could occur within that job step; and
- For each potential hazard, list the method to be followed to prevent the hazard causing an injury, loss, damage or environmental incident.

Weekly JHAs will be held in conjunction with the Toolbox meetings.

5.5.6. REPORTING AND AUDITING

During construction, there will be continuous review of the construction area and individuals and work crews will be required to demonstrate that the pertinent requirements of the EMP are being adhered to. Each supervisor will be required to record daily activities, on which relevant EMP requirements will be addressed (daily check sheets to be prepared by the construction contractor). Audits will include as a minimum, two construction audits (the first within two months of commencement) and two post-construction audits.

5.5.6.1. Incident reporting and non-conformance

Incident reporting will be implemented to record any safety or environmental non-conformances, incidents or complaints. These shall be recorded on an incident report form and forwarded to the Construction Manager for reporting within the Arrow system and for a process of continuous improvement to be implemented.

All such incidents shall be investigated in a timely manner and any necessary steps implemented to minimise likelihood of recurrence. If required, the EMP shall be reviewed and updated.

Non-conformances will be resolved according to a Quality Management Plan (QMP). The Environmental Manager or delegate will issue a Non-conformance Report (NCR) or an Environmental Improvement Notice (EIN) in response to poor or inappropriate work methods, equipment selection, maintenance of controls or other identified concern. An NCR will be issued for deficiencies that are minor in nature but require rectification. An EIN will be issued for more serious issues that present an immediate need for action, or for repeat non-conformances where a warning is required to be issued for poor performance.

In the event of an environmental non-conformance:

- The nature of the event will be investigated by the Environmental Officer;
- Advice may be sought from a specialist;
- Monitoring may be undertaken;
- The effectiveness or need for new / additional controls will be reviewed;
- An appropriate preventative and corrective action will be implemented;
- Strategies will be identified to prevent reoccurrence;
- The NCR will be closed-out; and
- Environmental documentation / Work Method Statement will be reviewed and revised.

If the environmental non-conformance is significant, it will be documented on the appropriate Health, Safety, Environment and Quality data management system.

5.5.6.2. Reporting

Section 320 of the EP Act requires that any person who becomes aware of an event that may or has caused environmental harm, reports the event / incident to their employer. Details of the nature and circumstances of the event must be provided.

Any such incidents must be immediately reported to the Construction Manager and recorded on an Incident Report Form. The Construction Manager will ensure that the appropriate external agencies are notified within the appropriate timeframe.

All such incidents shall be investigated in a timely manner and any necessary steps implemented to minimise likelihood of recurrence. If required, the EMP shall be reviewed and updated.

5.5.7. COMPLAINTS PROCEDURE

All complaints about the project will be directed to, and recorded by, the Community Liaison Officer. Contact details for the Community Liaison Officer will be provided to all affected landholders. A register will be kept recording details of all complaints received, the action taken in response (where necessary), and any corrective actions or procedural changes implemented to prevent recurrence.

The initiator of the complaint will be advised of the results of all actions taken with regard to that complaint.

The Community Liaison Officer will review the register daily and advise the Environmental Officer of any relevant complaints. The Environmental Officer will then investigate the complaint and instigate any corrective action required.

The register will be regularly audited by the Construction Manager to ensure adequate and timely response to any verified complaint is occurring.

5.5.8. REVIEW AND UPDATE

The EMP will be reviewed as required to ensure that it addresses environmental issues and changes in legislation, policies and guidelines (including work practices).

As requirements of design, construction methodology and environmental constraints are further identified, the EMP and site-specific plans will be updated and refined. The ‗living' nature of the EMP means that it will progressively improve and will continue to provide appropriate guidance for environmental protection throughout the construction phase.

5.6. CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

This section describes the environmental objectives and performance criteria for each environmental aspect relevant to the construction of the project. Management strategies to achieve the performance objectives and indicators are also provided. Specific monitoring requirements, reporting and corrective actions are also outlined for each environmental aspect.

5.6.1. AIR

Table 5-7: Air

Element / Issue	The pipeline will be constructed in a manner that causes no detriment to the short-term and long-term ambient air quality of the local airshed
Performance Objectives	▪ To minimise the generation of fugitive dust emissions produced during construction; ▪ To maintain acceptable limits of vehicular and machinery operating emissions; and ▪ To receive zero complaints from local landholders regarding air quality.
Performance Criteria	▪ The release of dust or any other airborne contaminants from the petroleum activity must not cause an environmental nuisance at any sensitive place or commercial place. ▪ Vehicular and machinery air emissions are maintained within manufacturer's specifications.
Implementation / Management Strategies	▪ Topsoil will be stockpiled and/or managed in an appropriate manner (i.e. separately from subsoil) and in appropriate locations (i.e. along the edge of high side of the ROW and away from watercourses) to avoid nuisance to sensitive receptors during windy conditions; ▪ Watering of construction site, access tracks and topsoil stockpiles will be carried out on an as-required basis, particularly on dry and windy days and especially near residential homesteads or where other people, including pipeline construction workers, may be operating; ▪ Dust impacts related to pipe transportation will be minimised by scheduling deliveries to daylight hours when watering can be carried out; ▪ Vehicles and machinery shall be maintained in accordance with manufacturer's specifications; ▪ The construction works program will be optimised to minimise haul distances for most construction materials to reduce fuel use; ▪ Running (idling) of engines for extended periods will be avoided; ▪ Raising awareness of energy efficiency and greenhouse gas emissions through workshops or toolkit talks; and ▪ Smoke generation will be avoided through the implementation of a strict no burning policy; ▪ Fire control measures will be implemented during welding operations; and ▪ Investigating greenhouse gas reduction initiatives at temporary workers' accommodation camps.
Monitoring	▪ Meteorological forecasts will be monitored daily to determine the necessary dust control measures; ▪ Regular inspections and visual monitoring undertaken in accordance with the EMP; ▪ Visual observations of dust emissions during windy / dry periods will be undertaken and watering frequency altered as required; and ▪ Photographic Records will record significant wind events.

Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ No Non-Conformance Report (NCRs) and Environmental Improvement Notice (EIN) issued in relation to air quality management.
Reporting	▪ Daily Check Sheets to record monitoring events, including visual evidence of dust or other emission events – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP and closed out by senior management.

Corrective Action	▪ Valid complaints will be acted on as soon as practical;
	▪ Recommendations and corrective actions implemented may include:
	  ▪ Increased frequency of watering to achieve further dust suppression;
	  ▪ Reducing speed limits; and
	  ▪ Limiting dust-generating activities.

Responsible Persons	▪ Construction Manager; and ▪ Environmental Officer.
Associated Documentation	▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.2. WATER

Table 5-8: Water

Element / Issue	Impacts to water quality and degradation to watercourses shall be avoided where possible and minimised through the implementation of targeted water protection measures and hydrostatic testing procedures.
Performance Objectives	▪ To minimise impacts on riparian and aquatic flora and fauna; ▪ To minimise erosion and sedimentation; ▪ To maintain existing water quality and water flow regimes; ▪ To maximise rehabilitation success of achieving long-term site stability; ▪ To minimise water use; and ▪ To ensure no detrimental impacts on soils, land use or surrounding water quality.
Performance Criteria	▪ Watercourse flows and channel crossings not significantly altered post-construction (as evidenced from monitoring photographs); ▪ Erosion and sediment control techniques implemented on site where necessary; ▪ Water quality controls maintained and in place; ▪ Watercourse banks and channels effectively reinstated to prevent scouring; ▪ Spill containment facilities constructed in accordance with AS 1940 and AS 3780; ▪ Evidence that rehabilitation measures have been successful; ▪ No spread of aquatic weeds and weed incursion into riparian areas at watercourse crossings; ▪ No adverse impacts on soil or surface water as the result of discharging hydrostatic test water; ▪ No discharge of hydrostatic test water to natural waterways; ▪ Compliance with limits for discharge of disposal of hydrostatic test water to land in accordance with the EA and Hydrostatic Pressure Test Management Plan; ▪ No erosion at site of hydrostatic test water discharge; and ▪ No existing water sources depleted to provide hydrostatic test water.
Implementation / Management Strategies	**Water quality** ▪ No refuelling of plant and equipment will be undertaken over or within 50 m of watercourses; and ▪ Waste and dangerous goods management strategies will be upheld at all times. **Watercourse crossings** ▪ Construction of watercourse crossings will be scheduled during the dry season wherever practicable when the intermittent rivers and streams traversed by the pipeline are generally not in flow; ▪ Meteorological forecasts (e.g. BOM website) will be monitored for storm and heavy rain events to assist in scheduling key activities; ▪ Trenching of watercourse crossings will be completed promptly and with due regard to the weather (i.e. construction will be scheduled for the dry season and postponed during significant rainfall and / or flood

	events); - In the Fitzroy River, Isaac River and Raglan Creek, horizontal directional drilling (HDD) construction methods shall be considered subject to geotechnical and hydraulic constraints; - Where an access track is required through a watercourse, this should be placed on the downstream side of the pipeline to minimise the potential for future erosion over the pipeline; - Watercourse crossings (including vehicle and maintenance tracks) will be constructed at right angles to the direction of water flow to minimise scour potential; - If the watercourse contains a sandy substrate, consideration will be given to the use of rock stabilisation for addition to the channel and embankments to prevent scour; - Relevant permits (including waterway barrier permits and permits to clear threatened vegetation) will be obtained where required; - Where practicable, mature riparian trees and rootstock will be retained for bank stabilisation; - Clearing widths should be minimised in the beds of watercourses; - The disturbance corridor for the bed, bank and approaches to watercourses will be the narrowest practicable for safe construction and existing access tracks will be utilised wherever practicable; - Pre-stripping and stockpiling of topsoil and bed material shall be undertaken. Material shall be stored separately in an area above the top of the bank where it will not be buried or damaged (this will aid in the re-vegetation process and minimise the chances of weed infestation); - Temporary earth banks shall be installed along the slope on approaches to watercourses immediately following clear and grade. This bank shall extend beyond the easement edge, in a manner which results in runoff water being discharged to the down-slope side of the pipeline to stable, preferably vegetated, discharge sites; - Additional stormwater diversion banks / drains (e.g. whoa-boys) are to be placed at a distance of 10 m back from each side of the top of the watercourse embankment; - Sediment fences shall be installed between the watercourse and the construction area and any soil or sediment stockpiles at all waterway crossings regardless of whether water is present; - Where it is necessary to pump water around the watercourse crossing, the outlet water should not be directed onto bank of the watercourse; - Watercourse banks will be reinstated as near as possible to their former profile, stabilised and revegetated as necessary to prevent scouring; - During reinstatement, banks shall be graded to a slope that is no steeper than the pre-existing site conditions; - During restoration, the creek or gully walls should be re-established to a stable slope consistent with the natural' slope on either side of the disturbed area;

	▪ Consideration will be given to seeding watercourse embankments with a fast growing native grass seed or other suitable fast growing species or the use of hydro mulching (in the event of dry conditions) to aid in rehabilitation; ▪ If the watercourse contains a sandy substrate, consideration will be given to the use of rock stabilisation for addition to the channel and embankments to prevent scour; ▪ Where the original streambed had a surface layer of cobbles and coarse gravels, care shall be taken to ensure that the material is replaced, or that weed-free imported rock of comparable structure is spread over the disturbed area; ▪ Monitoring of the watercourses before, during and after construction shall be undertaken to ensure that rehabilitation works and stability of the watercourses is comparable to pre-construction conditions; ▪ The Weed Management Plan being developed and implemented shall apply to the whole of the project and shall include a section aimed at preventing the spread of aquatic weeds and weed incursion into riparian areas at watercourse crossings; and ▪ In the event of flooding, remedial action will be taken in accordance with the Construction Emergency Response Plan where necessary. **Hydrostatic testing** ▪ A targeted Hydrostatic Pressure Test Management Plan (incorporating environmental protection measures) shall be developed and followed during all hydrostatic testing activities; ▪ The source of hydrostatic test water shall be approved in advance by the Construction Manager and Environmental Officer; ▪ Proposed hydrostatic test water sources will be inspected for adequacy of supply; ▪ Relevant permits to draw water shall be obtained as required; ▪ The Environmental Officer will check and approve hydrostatic test water discharge work methods; ▪ To prevent potential soil contamination or erosion, hydrostatic test waters will be filtered through a geotextile fabric or held in a temporary sediment retention basin in order to remove the majority of solid materials prior to discharge; ▪ The discharge of hydrostatic test water released between pipe sections will be discharged in such a way as to prevent flooding or erosion (e.g. against a splash plate or other dispersive device to aerate, slow and dissipate the flow); ▪ Hydrostatic test water discharge or recycling for secondary uses, such as pasture irrigation, will only be undertaken where water quality is within relevant water quality guidelines; ▪ Any holding ponds required for hydrostatic testing will be constructed as per applicable industry standards and regulatory requirements in consultation with landholders where necessary; ▪ Test water shall be discharged to land or a holding pond / farm dam (for evaporation or subsequent treatment and beneficial use) and will

	be in compliance with regulatory and landholder requirements. ▪ Inspection of all pipeline section welds or hydrostatic testing of pipeline sections before installation under watercourses, will be performed in accordance with construction specifications / procedures; and ▪ As far as is practicable, no aquatic weeds will be transferred from water sources to the pipeline during hydrostatic testing.
Monitoring	▪ Routine visual inspections undertaken to assess effectiveness of protection measures. Erosion control and sediment collection devices will be inspected regularly, particularly following high rainfall events; ▪ The water quality of watercourses, if flowing, shall be monitored both upstream and downstream of the construction area; ▪ Photographic Records to provide evidence that watercourse flows and channel crossings not significantly altered post-construction; and ▪ Hydrostatic test water quality will be tested prior to release if necessary to ensure results show compliance with regulated limits.
Auditing	▪ Regular audits and reviews undertaken in accordance with the EMP; and ▪ No NCRs and EINs issued in relation to water management.
Reporting	▪ Daily Check Sheets to record status of erosion and sediment controls, water quality and watercourse crossings – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP and closed out by senior management.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible Person	▪ Construction Manager; ▪ Environmental Officer; and ▪ Community Liaison Officer.
Associated Documentation	▪ Alignment Sheet; ▪ Environmental Line List; ▪ Weed Management Plan; ▪ Construction Emergency Response Plan; and ▪ Hydrostatic Pressure Test Management Plan.

5.6.3. NOISE AND VIBRATION

Table 5-9: Noise and vibration

Element / Issue	Noise and vibration nuisance to sensitive receptors is avoided and / or managed through effective project scheduling, the implementation of control measures and / or consultation with affected parties.
Performance Objectives	▪ To avoid noise nuisance generated by construction activities; and ▪ To avoid vibration nuisance to sensitive receptors.
Performance Criteria	▪ No valid noise- or vibration-related complaints received from residents during construction; ▪ Noise mitigation measures will be implement in accordance with AS 2436 and Ecoaccess guideline: *Noise and Vibration from Blasting (2006)*; ▪ Any blasting is to be carried out in accordance with current practice standards with particular reference to AS 2187; ▪ Blasting will meet the airblast overpressure criterion of a maximum of 120 dB (linear) peak for any blast; and ▪ A pre-construction condition survey on homesteads within 100 m of proposed blasting location will be conducted.
Implementation / Management Strategies	▪ Atypical noise events will be scheduled for appropriate times; ▪ Noisy construction activities including traffic movements in proximity to homesteads to be limited to between 6.00 am and 6.00 pm. ▪ Provide advance notice of any scheduled atypical noise events to nearby residents; ▪ Vehicles and equipment will be maintained in accordance with manufacturer's specifications and fitted with noise-reduction devices, where possible; ▪ Should any blasting be required, a condition survey will be conducted on any homesteads within 100 m of where the blasting is to occur; and ▪ Temporary workers' accommodation camps will be located a sufficient distance from residences to limit any noise nuisance.
Monitoring	▪ Construction equipment will be inspected regularly and maintained as per manufacturer's specifications; and ▪ Noise monitoring will be conducted if directed by the administering authority in response to a valid noise complaint..
Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; ▪ No NCRs and EINs issued in relation to noise and vibration management.
Reporting	▪ Pre-construction Homestead Condition Survey Report ▪ Daily Check Sheets to record noise and vibration – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP and closed out by senior management.

Corrective Action	▪ Recommendations and corrective actions implemented; and ▪ Evidence of prompt repair and replacement of faulty equipment likely to result in increased noise generation.
Responsible Person	▪ Construction Manager; and ▪ Environmental Officer.
Associated Documentation	▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.4. WASTE

Table 5-10: Waste

Element / Issue	To achieve waste avoidance as the preferred waste management strategy and to further minimise waste generation by maximising reuse and recycling of construction waste products; and To dispose of waste in the most appropriate manner where this is not possible.
Performance Objectives	▪ Minimise impacts related to waste management; and ▪ No evidence of litter or refuse generated from construction-related activities being left on the ROW; and ▪ No complaints from landholders regarding waste management.
Performance Criteria	▪ Appropriate disposal and management of waste; ▪ Clean and waste-efficient construction site; ▪ Percentage of waste recycled (as indicated through audits); and ▪ No litter left on site during construction.
Implementation / Management Strategies	▪ A Waste Management Plan will be developed by the construction contractor; ▪ Contamination from waste will be managed in accordance with a Contaminated Land Management Procedure. ▪ Reusable and recyclable wastes, such as timber skids, pallets, drums, scrap metals and circumferential fibre / nylon rope spacers used in pipe transport, shall be collected and stockpiled for recycling; ▪ All pipe delivery packaging (e.g. ropes, straps) will be removed from the ROW daily and disposed of appropriately; ▪ All binding material and dunnage from transport vehicles and unloading areas is to be collected and transported off the ROW to designated disposal areas; ▪ Wastes will be appropriately contained and / or covered to prevent access by stock or wildlife; ▪ General refuse shall be collected and transported to a Local Government approved disposal site; ▪ Lidded refuse containers will be located at each worksite; ▪ Declared plants detected on the ROW, will be eradicated and disposed of (e.g. sprayed and disposed of to regulated landfill) according to relevant legislation and guidelines; ▪ Chemical wastes (e.g. spent pipeline x-ray film developer chemicals if used) shall be collected in 200 L drums (or similar sealed container), appropriately labelled, for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service; ▪ Waste oil and solvents shall be collected by approved contractors for recycling, reuse or disposal at approved locations; ▪ Avoid storing and using chemicals in the immediate vicinity of watercourses; ▪ Sewage and sullage from camp sites shall be disposed of via a packaged mini STP (greywater may be discharged to land subject to compliance

	with relevant standards and regulatory approval conditions); and ▪ All personnel shall be instructed in project waste management practices as a component of the environmental induction process and toolbox talks.
Monitoring	▪ Regular reviews of the waste management register will be conducted to monitor the implementation of the waste management hierarchy; ▪ Photographic Records will be used as evidence of any key incidents; ▪ Regular housekeeping checks to be conducted; ▪ The quality and quantity of treated effluent (greywater) will be monitored in accordance with EA conditions if disposed to land; ▪ Results of campsite inspections after they are decommissioned; and ▪ Regular inspections undertaken in accordance with the EMP.
Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ No NCRs and EINs issued in relation to waste management.
Reporting	▪ Daily Check Sheets to include a waste management register – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out by senior management; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible Person	▪ Construction Manager; and ▪ Environmental Officer.
Associated Documentation	▪ Contaminated Land Management Procedure; ▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.5. LAND MANAGEMENT

5.6.5.1. Soils (including erosion and sediment control)

Table 5-11: Soils (including erosion and sediment control)

Element / Issue	Construction impacts to soils, watercourses and the general environment shall be minimised through the implementation of effective erosion, sedimentation and soil conservation controls and the establishment of a stable ROW.
Performance Objectives	▪ To control and minimise soil erosion and sedimentation of land throughout key construction activities (including clear and grade, trenching, pipe stringing and welding; and pipe laying and backfill); ▪ To preserve topsoil quality for future land use by minimising soil inversion, mixing or burial of topsoil; ▪ To avoid long-term adverse impact on good quality agricultural land (GQAL); ▪ To manage dangerous goods in a manner that maintains safety and minimises risks of land and soil contamination; ▪ To preserve the quality of root stock and seedstock; ▪ To minimise modification to drainage patterns and prevent (as far as practical) sediment transport to adjacent watercourses; ▪ To minimise impacts to landholder and community values (e.g. visual amenity and land use potential); and ▪ To develop a stable, vegetated ROW post construction.
Performance Indicators	▪ Avoid erosion and sedimentation to adjacent land uses as a result of construction activities where possible; ▪ Erosion will be minimised and mitigated where avoidance is not practical; ▪ Erosion and sedimentation control measures are implemented along the ROW in areas of instability; ▪ No evidence of additional sedimentation in watercourses as a result of erosion from construction activities; ▪ Stormwater diversion drains are adequately spaced in areas of erosion potential; ▪ Evidence that soil has been effectively segregated from topsoil and vegetation; ▪ No spoil at surface on completion of backfilling; ▪ Time between excavation and backfilling is effectively minimised; ▪ Subsoil is returned to trench prior to topsoil; ▪ No inversion of subsoil and topsoil; ▪ Well-compacted trench line with appropriately installed trench breakers and contour banks; ▪ Reinstatement of watercourses to original profile; and ▪ Stormwater drains placed to divert stormwater away from operational easement in melon-hole country.

Implementation / Management Strategies	**Erosion and sedimentation**
	▪ For any temporary additional work areas required outside the ROW, for example, laydown areas for the pipe, access tracks or additional areas required for the safe construction of the pipeline, these will be negotiated with the relevant landowner;
	▪ Appropriate erosion and sediment control measures (including sediment fences, berms and diversion drains) will be installed and maintained during construction;
	▪ The extent and duration of soil exposure and stockpiling will be limited through appropriate work scheduling;
	▪ Critical areas will be protected during and after construction by reducing the velocity of stormwater flow and redirecting runoff onto undisturbed areas;
	▪ Where required, trench breaks will be utilised at appropriate intervals to minimise erosion and allow access across the ROW as required. The location of trench breaks will depend on slope, soil type and local conditions;
	▪ Modified landforms will be re-contoured to their original condition as soon as practicable including any erosion controls established prior to construction;
	▪ Erosion and sediment control measures along the ROW will be regularly inspected and maintained during and after construction until stabilisation is achieved;
	▪ Should the trench require dewatering in wet weather, water is to be pumped out and disposed of across grass and not directly into stormwater drains or creeks;
	▪ Permanent stormwater diversion drains shall be installed on all hilly slopes (approximately 20 m intervals, depending on slope). Particular care will be taken in areas with sodic soils subject to a high erosion potential;
	▪ Silt mesh fencing, hay bales and stormwater diversion drains shall be installed on the banks of all waterways containing flowing water during construction;
	▪ Highly erodible soils shall be identified through visual inspection of the route to identify the extent and location of existing soil erosion;
	▪ Where highly erodible soils are identified, and if the area cannot be reasonably avoided, the following controls shall be implemented:
	    ▪ The work area will be kept to a minimum where safe to do so, to ensure that the smallest possible ground area is disturbed;
	    ▪ Erosion control structures (such as diversion drains and silt fences) will be installed at key locations to capture the suspended sediment; and
	    ▪ Stormwater will be diverted away from the exposed soil to reduce overland flow or channel flow on the vulnerable soils.
	▪ For wet waterway crossings, the following sediment controls should be implemented:
	    ▪ Erosion control structures (such as silt fences, flotation curtain, sand

	bags and hay bales) will be placed in and/or adjacent to the channel to capture suspended sediment; ▪ Following reinstatement at wet crossings, all imported materials shall be completely removed from the site; ▪ Stormwater will be diverted away from disturbed channels or swales to minimise the flow of water and erosion potential; ▪ Where necessary, temporary access may need to be constructed across small swales and channels to minimise channel disturbance; ▪ If flow modification is necessary during construction, channels will be reinstated on completion of works; and ▪ All existing erosion control structures will be reinstated on completion of works. ▪ Stormwater diversion commitments shall include: ▪ In areas which are subject to erosion potential (slopes >5%), stormwater diversion banks / drains shall be placed diagonally across the ROW to divert stormwater to adjacent undisturbed grassed areas following completion of construction. Spacing of such diversion drains can be approximately 50 m to 70 m apart. Where slopes are >5%, then more frequent spacing is required. Areas containing steep inclines include AB53.9, AB93.1-93.9, AB280-281, AB293.8-294, AB317.2-317.4, AB314.4-314.7 and AB317.3-317.5. ▪ Diversion banks shall be used at the crest of the stream approach slope and on the slopes to divert sheet flow away from backfilled trenches. Each diversion bank should have a stabilised outlet to disperse channelled flows on the downstream side of the easement; ▪ Diversion drains, to divert stormwater away from the restored pipeline easement, will be installed where required. This is particularly important in melon-hole country in the vicinity of AB138-142.5, AB154-158, AB183-184, AB185-186, AB187.7-188.6, AB190.5-193, AB154-158, AB218.15-221.9 and AB259-261; ▪ Monitoring (and restoration work where necessary) will be undertaken following construction to ensure erosion is promptly addressed; and ▪ Alternate diversion mechanisms will be considered in areas where soil disturbance may expose sodic soil and increase erosion potential. ▪ In the unlikely event that material extraction sites are required (e.g. borrow pits) they will be located in suitable areas with a low erosion and sedimentation potential and all required approvals and landholder consent will be obtained. **Topsoil management** ▪ Topsoil containing seed stock will be graded from the ROW and stockpiled along the edge of the ROW for later return and spreading across the ROW during rehabilitation; ▪ The importation of soils, to compensate for any subsidence losses, may be undertaken in certain areas subject to landholder agreement and the implementation of strict weed / pest control procedures;

	▪ Graded soil, cleared vegetation and seed stock will be stockpiled where it can be readily recovered for respreading and where loss through wind, or water erosion or other means will be minimised; ▪ Topsoil will be stripped across the ROW (typically between 100 and 300 mm) and any newly created access tracks and stockpiled separately to protect topsoil, root and seed stock and for reuse to prevent inversion of soils during rehabilitation. Topsoil will be placed on the high side of the ROW (away from watercourses) where it is safe to do so; ▪ The stockpiles will be breached in appropriate locations (coinciding with designated access roads or tracks, fence lines) to allow vehicular, stock and wildlife access or surface water drainage. Vehicular movement over stockpiled soil will not be allowed; ▪ Spoil will be stockpiled outside watercourses, and / or behind containment structures so as to prevent siltation of any land or surface water or blockage of any existing drainage channels; ▪ Topsoil and seed stock will be replaced to facilitate revegetation as soon as practicable following construction; ▪ Topsoil will only be reinstated after the excavated spoil has been backfilled and compacted; ▪ Soil and surface stability will be maintained at all times (e.g. temporary erosion control berms, cut-off drains and sediment barriers shall be installed as necessary and maintained until final construction clean-up is completed); ▪ Cleared vegetation to be placed in windrows as necessary at the edge of the ROW for respreading back across the ROW during rehabilitation as required (where safety will not be impaired) to assist in erosion prevention with the consent of landholders; ▪ Diversion drains will be used in conjunction with windrows of cleared vegetation where necessary, to counter potential diversion of overland flow and associated impacts resulting from windrow placement; ▪ In melon-hole country (AB138-142.5, AB154-158, AB183-184, AB185-186, AB187.7-188.6, AB190.5-193, AB154-158, AB218.15-221.9 and AB259-261), particular care is to be taken to carefully remove and segregate the topsoil from the subsoil and return the soil in order of profile; ▪ Mixing of spoil (sub-soils) with topsoil or cleared vegetation will be prevented; ▪ Appropriate means (such as trench breakers and compaction of backfilled soils) will be used to prevent erosion along the backfilled trench; ▪ Vehicles will be prevented from driving over topsoil stockpiles to prevent compaction; ▪ Topsoil will not be used as padding or backfill; ▪ Any areas identified as previously contaminated will be avoided; and ▪ For turn around areas, lay down areas for pipe, temporary access tracks and other temporary areas required for the safe construction of the pipeline, these additional areas outside the RoW will be negotiated with

	the relevant landholder.
Monitoring	▪ Photographic Records; ▪ Regular inspections will be undertaken along the length of the ROW in accordance with the EMP to assess the effectiveness of protection measures.
Auditing	▪ Construction audits will include all watercourse crossings; ▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; ▪ A post-construction audit which will evaluate revegetation, erosion control, weed control, water course bank stability will be conducted annually for two years following completion of construction; and ▪ No NCRs and EINs issued in relation to waste management.
Reporting	▪ Daily Check Sheets to record waste management – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible Person	▪ Construction Manager; ▪ Environmental Officer; and ▪ Community Liaison Officer.
Associated Documentation	▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.5.2. Temporary workers' accommodation camps

Table 5-12: Temporary workers' accommodation camps

Element / Issue	The impact on the environment (including land, water, nature conservation values and nuisance) from temporary workers' accommodation camp sites and construction compounds will be reduced to as low as reasonably practicable.
Performance Objectives	▪ To receive zero complaints from local landholders with regard to nuisance; ▪ To cause minimal impact on the natural environment; ▪ To achieve compliance with Local Government requirements for provision of infrastructure and waste disposal; ▪ To establish and maintain functional waste minimisation, segregation and recycling systems at all worksites; ▪ To ensure a high standard of site management and general housekeeping; ▪ To avoid the spread of pest species and pathogens. ▪ To ensure activities do not encourage vermin or mosquito breeding; ▪ To manage storage of dangerous goods substances in a manner that maintains safety and minimises risks of land and soil contamination; ▪ To minimise impacts to water quality, watercourses and drainage patterns; ▪ To minimise impacts associated with noise nuisance and deterioration of air quality; ▪ To minimise disturbance to native flora and fauna; ▪ To ensure adequate stakeholder consultation through the construction phase; and ▪ To reinstate the site to equivalent surrounding conditions following project use.
Performance Indicators	▪ Clean and tidy camp site (as captured in inspection records); ▪ Waste management, waste disposal and waste recycling measures in place; ▪ No unplanned or unapproved damage to flora and fauna communities; ▪ Installation and maintenance of erosion control devices; ▪ Camp site and construction compounds successfully rehabilitated following completion of the project.
Management Strategies	▪ Camp sites will be located following agreement with landholders and / or local government approvals; ▪ Consideration will be given to the potential of flooding caused by extreme weather events when locating temporary workers' accommodation camps; ▪ Camp sites and construction compounds will be selected to minimise impacts on sensitive vegetation, erosion-prone soils and watercourse crossings; avoid any significant cultural heritage sites and to minimise noise to any nearby residents;

	▪ Wherever possible clearing of remnant vegetation areas should be minimised for the purposes of situating construction camps, laydown areas, vehicle access tracks and other ancillary impact areas; ▪ Wastes will be disposed of in accordance with regulatory approval conditions, relevant legislation and the requirements of local government; ▪ Camp effluent will be treated in a packaged sewage treatment plant; ▪ Total petroleum hydrocarbon (TPH) soil testing of the area containing temporary fuel storages will be conducted following removal of these storages; ▪ Waste will not be burnt; ▪ The Stakeholder Consultation Plan will be implemented; and ▪ Following use, camp sites and construction compounds will be reinstated and re-vegetated to as near as practical to their original condition.
Monitoring	▪ Photographic Records; ▪ Regular inspections undertaken in accordance with the EMP; and ▪ Regular inspection of storage facilities and work practices in the handling of flammable and combustible substances or other dangerous substances.
Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ No NCRs and EINs issued in relation to operating the temporary workers' accommodation camps.
Reporting	▪ Daily Check Sheets – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible Person	▪ Construction Manager; and ▪ Environmental Officer.
Associated Documentation	▪ Alignment Sheet; ▪ Environmental Line List; and ▪ Stakeholder Consultation Plan (SCP).

5.6.5.3. Dangerous Goods (including flammable and combustible substances)

Table 5-13: Dangerous goods (including flammable and combustible substances)

Element / Issue	To ensure that the storage and handling of dangerous goods (particularly flammable and combustible substances) does not result in environmental harm or safety impacts.
Performance Objectives	▪ To minimise potential for land and water contamination; ▪ To minimise the potential for bushfires; and ▪ To ensure the on-going safety of construction personnel.
Performance Criteria	▪ No hazardous goods contamination of the environment; ▪ Zero incident records; ▪ Storage and handling procedures correct and appropriate; ▪ Where practicable, the flowpath to drains / watercourses from dangerous goods storages is effectively blocked (e.g. sand bags, earthen bund) to reduce the potential for water contamination in the event of a spill); and ▪ Spill kits and PPE available and used as appropriate.
Management Strategies	▪ A qualified person will be appointed as Site Safety Officer; ▪ An Emergency Response Plan shall be in place and employees inducted in its application; ▪ Relevant Local Government permits will be held and conditions of permits obtained; ▪ Flammable and combustible substances are stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS 1940; ▪ Explosives will be stored as per AS 2187; ▪ Transportation of dangerous goods will be in accordance with the relevant legislation and standards (including AS 1678, AS 2809 and AS 2931); ▪ An on-site set of the relevant Material Safety Data Sheets (MSDS) for all flammable and combustible substances and dangerous goods used during construction will be maintained and available; ▪ Waste flammable and combustible substances which cannot be recycled will be transported to a designated disposal site as approved by Local Government; ▪ No refuelling of plant and equipment shall be undertaken within 50 m of watercourses; ▪ Spill kits containing absorbent containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use; ▪ Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at a designated site, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area; and ▪ Personal protective equipment (PPE) appropriate to the materials in use will be provided.

Monitoring	▪ Photographic Records; ▪ Regular inspection of storage facilities and work practices in the handling of flammable and combustible substances or other dangerous substances; and ▪ Regular inspections undertaken in accordance with the EMP.
Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ No NCRs and EINs issued in relation to managing dangerous goods.
Reporting	▪ Daily Check Sheets – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Records of appropriate remedial action undertaken for any incidents (e.g. spills); ▪ Major incidents reported to relevant authorities and their directions followed; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible person	▪ Construction Manager; and ▪ Environmental Officer.
Associated documentation	▪ Construction Occupational Health and Safety Plan; ▪ Construction Safety Management Plan ▪ Contaminated Land Management Procedure; ▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.5.4. Acid sulfate soils and contaminated land

Table 5-14: Acid sulfate soils and contaminated land

Element / Issue	Soil contamination and environmental damage from acid sulfate soil (ASS) exposure will be minimised through effective land management practices.
Performance Objectives	▪ To minimise potential conversion of ASS through site work; ▪ To prevent environmental harm caused by site works including dewatering in areas containing ASS; and ▪ To prevent land contamination and effectively store and handle dangerous goods.
Performance Criteria	▪ No environmental harm (e.g. fish kills) as the result of exposure of acid sulphate soils; ▪ ASS neutralised or sealed against air ingress if the trench is to be left open longer than 8 hours; ▪ ASS spoil monitored for field pH (acceptable range 6 – 9); and ▪ Spill kits and PPE available and used as appropriate. ▪

Management Strategies	▪ Prior to construction commencement, a soils assessment will be undertaken in key areas along the pipeline (identified through desktop assessment) that may potentially contain ASS (particularly in low lying ASS prone areas such as in the vicinity of Inkerman Creek). The assessment will be in accordance with Guidelines described in Lowland Acid Sulfate (ASS) in Queensland 1998; ▪ In areas where ASS is potentially located, exposure to air for extended periods without prior treatment will be controlled. Treatment shall include limiting exposure to air, testing for pH and addition of lime; ▪ Known contaminated areas will be avoided where possible and procedures will be developed for handling previously unidentified contaminated areas (including Potential ASS). These may include temporary cessation of trenching and recommencement ahead of the area (e.g. 50 m); ▪ Stockpiles of spoil potentially containing ASS will be checked for pH and (if necessary) the pH adjusted using lime; ▪ Total petroleum hydrocarbon (TPH) soil testing of areas containing temporary fuel storages (e.g. temporary worker accommodation camps) will be conducted following removal of storage facilities; ▪ Should the trench require dewatering (in areas subject to ASS), the pH of the water shall be checked, adjusted to neutral using hydrated lime and the neutralised water disposed over grassed or vegetated areas and not directly to any watercourse or drains; ▪ Spill kits containing absorbent containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use; ▪ Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at a designated site, including cleaning materials, absorbents and contaminated soils and reinstatement made to the affected area; and ▪ Dangerous goods (including flammable and combustible substances) shall be stored and handled in accordance with relevant legislation and standards (including AS 1940).
Monitoring	▪ A soil investigation program will be developed to include checking of pH in ASS prone soils; ▪ Monitor any fish kills; ▪ Photographic Records; ▪ The appropriate use of PPE will be defined in the Construction Occupational Health and Safety Plan; ▪ Regular inspections, audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP. Recommendations and corrective actions implemented; and ▪ Regular inspection of storage facilities and work practices in the handling of flammable and combustible substances or other dangerous substances.

Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ No NCRs and EINs issued in relation to managing ASS.
Reporting	▪ Records of appropriate remedial action undertaken for any incidents; ▪ Major soil contamination incidents (spills etc) reported to relevant authorities and their directions followed; ▪ Daily Check Sheets – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible person	▪ Construction Manager; and ▪ Environmental Officer.
Associated documentation	▪ Construction Occupational Health and Safety Plan; ▪ Contaminated Land Management Procedure; ▪ Soil Investigation Program; ▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.5.5. Fire risk

Table 5-15: Fire risk

Element / Issue	The project will be managed in a manner that reduces the risk of fire (and associated impacts to the environment and community) from construction activities.
Performance Objectives	▪ To ensure that no fires are deliberately or accidently lit, or allowed to remain alight, along the ROW or other project-related worksites; and ▪ To minimise build-ups of flammable material during construction near hot work areas.
Performance Criteria	▪ No fires along the ROW as a result of construction activities; ▪ No build-up of flammable material near hot work areas; ▪ Current approved Emergency Response Plan in place; and ▪ Relevant permits and approvals in place as required. ▪

Management Strategies	▪ Open fires will be banned on the project. Fires include open barbeques, billy fires, brush burning and rubbish burning;
	▪ The pipeline contractor will liaise with local Rural Fire Service representatives during periods of high fire danger to determine required work limitations;
	▪ Unnecessary build-up of flammable material near working areas will be prevented, with vegetation and other flammable material being stockpiled well clear of hot work activities;
	▪ Water trucks (also used for dust suppression) will be available for use as fire trucks in the event of fire;
	▪ All relevant local laws will be complied with in relation to fire management;
	▪ All vehicles will be equipped with portable fire extinguishers;
	▪ Fire extinguishers and a water cart will be available to the welding crew;
	▪ All appropriate crew members will be trained in the use of fire fighting equipment;
	▪ A fire risk management strategy will be addressed in the project HSE plan;
	▪ Emergency Response Plan shall include details on local contacts for fire fighting assistance;
	▪ All welding equipment and welding procedures will conform to relevant Australian Standards;
	▪ The following precautions will be taken to minimise the possibility of fire due to welding activities:
	    ▪ The actual strip of land along the ROW over which welding will take place will be cleared of combustible vegetation and therefore reduce the risk of fire; and
	    ▪ Stockpiled vegetation will be separated from welding activity.
	▪ Dangerous goods (including flammable and combustible substances) shall be stored and handled in accordance with relevant legislation and

	standards (including AS 1940).
Monitoring	▪ Adherence to welding procedures and SWMS; and ▪ Regular inspections, audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP. Recommendations and corrective actions implemented.
Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ No NCRs and EINs issued in relation to fire management.
Reporting	▪ Daily Check Sheets – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Actions	▪ Recommendations and corrective actions implemented.
Responsible Person	▪ Environmental Officer; and ▪ Community Liaison Officer.
Associated Documentation	▪ SWMS ▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.6. CLEAN UP AND REHABILITATION

Table 5-16: Clean up and rehabilitation

Element / Issue	As far as reasonably practicable, the ROW and immediate surrounds will be restored to their pre-disturbed state to maintain environmental values and enable the continuance of existing land uses.
Performance Objectives	▪ To minimise soil erosion and sedimentation; ▪ To preserve current and future surface and groundwater quality; ▪ To ensure that topsoil is re-established to a condition that supports agricultural land uses; ▪ To achieve a stable ROW landform; ▪ To minimise modification of drainage patterns and preserve surface and ground water quality; ▪ To stabilise, revegetate and reinstate watercourse banks to their former profile as far as practicable; ▪ To prevent and / or control weed invasion; ▪ To maintain and / or restore visual amenity values along the ROW; and ▪ To minimise adverse impacts on GQAL and other land uses.
Performance Criteria	▪ No new weed species introduced; ▪ A weed management program implemented; ▪ Rehabilitation success (including vegetation re-establishment and soil stability) for benchmark ecosystem monitoring sites (as described above); ▪ Revegetation success in disturbed areas (including percentage groundcover of desirable species and groundcover re-established); ▪ No change in drainage pattern leading to soil erosion; ▪ Erosion and sedimentation control measures are implemented along the ROW in areas of instability; and ▪ Watercourse integrity (including bank stability and water flow) will be effectively maintained.
Management Strategies	▪ Stockpiled topsoil and seed stock will be re-spread on graded surfaces in an even layer to assist natural regeneration. Minor surface roughness will be encouraged when spreading topsoil to trap water and seeds; ▪ Subsoil displaced by the pipe, and not utilised, may be stockpiled in locations approved by the landholder for later use; ▪ Subsoil will be returned to the trench prior to the respreading of topsoil to best maintain the original soil profile in a given area; ▪ If required for easement repairs, imported topsoil will only be used if weed free and approved by the landholder; ▪ Flagging, used to identify clearing boundaries and sensitive features, will be removed; ▪ Hollow-bearing logs will be left at the side of the ROW to provide shelter for fauna where safety is not compromised; ▪ Cleared vegetation, not re-spread across the ROW, may be removed and disposed of in consultation with the appropriate landholder; ▪ Compaction relief will be undertaken where required by scarifying soils along the contours; ▪ The pipeline construction area will be re-profiled to original or stable

	contours, re-establishing surface drainage lines and other land features; ▪ Soil protection, erosion and sediment control measures shall be implemented throughout relevant rehabilitation efforts; ▪ Above ground infrastructure (e.g. valves) shall be fenced to discourage third party and stock entry; ▪ Fences or other barriers shall be installed where appropriate and where approved by the landholder to minimise unauthorised easement access; ▪ Permanent pipeline marker signs shall be erected along the easement; ▪ All waste materials and equipment will be removed from the pipeline construction area once backfilling and tie-ins are completed; ▪ Material shall be returned to same general area from which it was extracted to minimise the risk of the spread of weeds and declared plants; ▪ Where disturbed areas are to be re-planted or re-seeded, preference will be given to the use of local provenance native species sourced from a local seed bank. However, non-native and non-invasive grass seed stock may be used where approved by the landholder to provide environmentally acceptable short term surface stability; ▪ Seed mixtures will be formulated for the conditions of the area; ▪ Where applied, seed will be evenly dispersed over the entire disturbed area; ▪ Seeding will take place as soon as practicable during clean up; ▪ Fertilisers and soil supplements will be used only as necessary (and only with landholder approval), and shall be minimised to reduce the risk of increasing nutrient levels in watercourses; ▪ Watercourse banks will be reinstated as near as possible to their former profile, stabilised and revegetated as necessary to prevent scouring; ▪ Consideration will be given to seeding watercourse embankments with a fast-growing native grass (e.g. *Themeda australis*) or other suitable fast-growing species, or the use of hydro mulching (in the event of dry conditions) to aid in rehabilitation; ▪ Native groundcover, shrubs and trees will be allowed to regenerate naturally to minimise habitat barrier effects. Trees will be prevented from establishing within 3.5 m each side of the pipe centreline due to safety considerations; ▪ Vegetation re-establishment will be monitored during and after construction; and ▪ Where practicable (and where safety is not compromised) timber should be stick raked into piles and left to provide animal habitat and to assist in revegetation and erosion control.
Monitoring	▪ Photographic Records (recorded at monitoring sites); ▪ Regular inspections, audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ Regular easement inspections.

Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ Post construction audits; and ▪ No NCRs and EINs issued in relation to managing clean up and rehabilitation.
Reporting	▪ Daily Check Sheets – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible Person	▪ Environmental Officer; ▪ Construction Manager; and ▪ External auditor.
Associated Documentation	▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.7. COMMUNITY AND SOCIAL ENVIRONMENT (INCLUDING CULTURAL HERITAGE)

Table 5-17: Community and social environment (including cultural heritage)

Element / Issue	Impacts to social and community values within the project area (including infrastructure and cultural heritage values) will be avoided or minimised through the implementation of targeted management strategies and control measures.
Performance Objectives	▪ To minimise disruption to landholder activities and third parties; ▪ To adequately protect public safety during construction and operations; ▪ To avoid impacts to visual amenity and maintain the scenic value of natural and rural landscapes; ▪ To retain the entire stock route network with minimal disruption to allow continued flow of travelling stock; ▪ To minimise impacts to native flora and fauna; ▪ To minimise impacts to soil and water; ▪ To safely manage the transportation of construction equipment and materials (including pipe); ▪ To use existing roads wherever possible and minimise the construction of additional roads and tracks; ▪ To minimise disturbance or damage to land-use / infrastructure (including road networks) and remediate where disturbance cannot be avoided; ▪ To prevent the spread of weeds, declared plants and diseases as a result of construction activities; ▪ To avoid fires associated with pipeline construction and operations / maintenance activities; ▪ To avoid impacts to cultural and historic heritage values during construction; and ▪ To appropriately reinstate and rehabilitate the easement to allow continuation of current land use activities post construction; and
Performance Criteria	▪ Access readily manageable and able to be rehabilitated using standard techniques; ▪ No justified complaints from landholders, Government authorities and the public; ▪ Records of cultural heritage monitoring during clear and grade as required in accordance with the CHMP; ▪ Erosion and sediment controls are installed and maintained; ▪ Condition of existing roads and tracks are maintained; ▪ Pipe transport managed in line with the TMP; ▪ Road condition not deteriorated as a result of project activities or made good following deterioration caused by project activities; ▪ Findings of environmental inspections and audits indicate compliance with social commitments; ▪ No evidence of unauthorised disturbance of cultural or historic heritage items; ▪ A SCP is developed and implemented; ▪ A Social Impact Management Plan (SIMP) is developed and

	implemented; ▪ No NCRs and EINs issued in relation to social issues; and ▪ CHMPs and HHMP are in place and effectively implemented.
Management Strategies	**Access, transport and traffic** ▪ The SCP shall be implemented throughout construction; ▪ The TMP, developed in consultation with local government, Department of Transport and Main Roads (DTMR) and Queensland Police Service, shall be implemented throughout construction; ▪ A targeted Road Maintenance Team will monitor and repair roads during the construction period, and make good any roads following the construction phase; ▪ Existing roads and tracks will be used where practicable; ▪ Access for landholders will be maintained at all times; ▪ Pipe will be strung, allowing gaps for access across the line of pipe. Gaps will coincide with access roads, tracks and boundaries wherever practicable, and will be located in consultation with relevant landholders to enable the continuation of existing land uses; ▪ Where necessary, signage will be installed at road crossings and entry points to discourage public access; ▪ Work undertaken in proximity to public utilities and infrastructure owned or managed by third parties (including Queensland Rail, DTMR and local government, and mining and petroleum entities) will be undertaken through direct consultation with the affected party and in compliance with relevant policies, legislation and permitting requirements; ▪ The vehicle loads for the delivery scheduling will adhere to specific load limits on the access routes to be used; ▪ New access tracks and any diversions will generally be avoided, but if necessary, will be selected to minimise impacts on sensitive vegetation and habitat values, erosion-prone soils, watercourse crossings; cultural and historic heritage items and noise sensitive receptors; ▪ New access tracks will only be constructed under agreement with the landholder; ▪ There will be no permanent disruption to stock routes and the relevant DERM Senior Lands Officer (stock routes), local government stock route officer and landholders will be consulted to minimise any potential temporary disturbance to stock mobilisation; ▪ Stock routes will generally be crossed at close to right angles to the routes; ▪ Except for some instances associated with specific purposes (e.g. rehabilitation of topsoil, protection of heritage sites, safety hazard control, etc.), the pipeline construction ROW will not be fenced; ▪ Temporary fencing will be erected where appropriate to prevent stock access to fuel or potential contaminants; ▪ Temporary gates will be replaced and breached fencing reinstated to pre-construction condition as agreed with the landholder; ▪ Temporary access tracks will be removed (unless otherwise agreed with the landholder) and rehabilitated (land contoured to pre-disturbed state,

	topsoil replaced and erosion protection measures installed; ▪ Disturbance (including access) to No-go areas shall be avoided. These shall be marked with flagging tape, paraweb fencing or equivalent; ▪ Where practical, access to the ROW will be from where existing public roads cross the pipeline; ▪ Speed and weight restrictions will be applied to project vehicles as appropriate (especially on unsealed roads); ▪ Any damage to existing roads and tracks shall be repaired; ▪ Transport of equipment and materials (including pipe) will be undertaken in accordance with the TMP (developed in conjunction with local governments, QPS and DTMR); ▪ Local Governments will be involved in discussions regarding the use of local aerodromes for FIFO arrangements of aircrafts within the broader project region; ▪ A road condition survey of roads used by the project will be undertaken prior to construction as a baseline assessment of existing values to be protected or reinstated; ▪ When necessary, pipe trucks will queue in a safe location to avoid traffic nuisance; ▪ Major road crossings will be under bored; ▪ Open cut crossing of roads and watercourses will be managed in consultation with landholders and third parties. Installation of by-pass tracks or detours will be undertaken as required; and ▪ Pipe laying crews will prepare for identified third party crossings and will have materials and equipment available. **Public risk and safety** ▪ Targeted consultation will be undertaken to ensure that stakeholder safety issues are understood and addressed; ▪ Measures including pipeline markers and landholder liaison will be used to alert third parties to the presence of the buried pipeline. Markers will be installed with appropriate regard to land use; ▪ Permanent pipeline marker signs shall be erected along the easement in clearly visible locations and in accordance with AS 2885; ▪ Strict fire control commitments and procedures will be maintained to minimise fire safety risks; ▪ The location of existing third party infrastructure in the ROW will be accurately identified on alignment sheets and marked on the ground or exposed by hand prior to trenching activities; and ▪ The delivery of equipment and materials (including pipe) shall be safely managed in accordance with the TMP. **Land use values and visual amenity** ▪ Formal easement agreements will be made with affected landholders, outlining the legal responsibilities of both parties; ▪ Arrow will work closely with landholders and managers to minimise conflict with existing land use activities; ▪ Agreed impacts or modifications will be appropriately noted on the line list; A complaints register will be established and maintained and complaints

	followed up; ▪ Impacts to landholders will be minimised (e.g. installation of gates and cattle grids to allow access to pipeline easement, and temporary fencing to control livestock where appropriate); ▪ Vehicles and personnel are to remain on the construction ROW, unless at designated work and turnaround areas; ▪ Appropriate land management control measures will be implemented to effectively minimise soil impacts; ▪ Noise will be minimised through effective scheduling of activities and landholder consultation; and ▪ The construction ROW will be rehabilitated in consultation with landholders. **Cultural heritage and historic values** ▪ Cultural heritage management strategies (outlined in the CHMPs and developed in conjunction with indigenous groups along the pipeline route) will be implemented; ▪ The Historic Heritage management strategies outlined in the HHMP will be implemented; ▪ The final pipeline route will be selected to avoid cultural heritage and historic sites as far as practicable; ▪ A formal induction / briefing will be provided to pipeline construction personnel prior to the commencement of construction, to ensure that there is appropriate awareness of the location of heritage and historic sites and the appropriate measures that will be undertaken to ensure their protection; ▪ Local Aboriginal monitors will conduct pre-clearance surveys for clear and grade activities as required by the CHMP; and ▪ Historic artefact material will be handled, stored and conserved in accordance with the HHMP.
Monitoring	▪ Photographic records of site conditions; and ▪ Regular inspections undertaken in accordance with the EMP.
Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP.
Reporting	▪ Daily Check Sheets – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
ResponsiblePerson	▪ Construction Manager; ▪ Community Liaison Officer; and ▪ Cultural Heritage Liaison Officer.

Associated Documentation	▪ TMP, SCP, SIMP; ▪ Biosecurity Management Strategy; ▪ Construction Safety Management Plan; ▪ Road condition assessment; ▪ Maps of access tracks; ▪ CHMPs and HHMP; ▪ Alignment Sheet; and ▪ Environmental Line List.

5.6.8. NATURE CONSERVATION

Table 5-18: Nature conservation

Element / Issue	Impacts to nature conservation values will be minimised through the implementation of flora and fauna protection measures and effective control of pest species.
Performance Objectives	▪ To minimise impacts to native vegetation; ▪ To avoid or reduce disturbance to endangered, vulnerable and near threatened flora species; ▪ To minimise habitat fragmentation; ▪ To offset any rare, endangered or vulnerable plants disturbed by construction; ▪ To prevent the spread of weeds, diseases and animal pests as a result of construction activities; and ▪ As far as reasonably practicable, prevent movement of pest animals across declared barrier fences.
Performance Criteria	▪ Minimal disturbance of terrestrial flora and fauna during construction of the pipeline and associated access tracks and temporary worker accommodation camps; ▪ Ramps and fauna exit points are effectively installed and maintained; ▪ No damage to protected species without relevant permits in place; ▪ No presence of exotic grasses in pristine native grass communities; ▪ Relevant permits are in place before removing any protected species; ▪ Declared plants within the ROW have been removed promptly following discovery; ▪ Evidence of effective restoration of disturbed areas to promote groundcover following construction; and ▪ No significant failure of rehabilitation measures.
Management Strategies	**Flora** ▪ Pre-construction surveys shall be conducted for EVNT and regionally significant flora species. Surveys shall include the 30 m ROW of the final route and immediately adjacent areas that may be disturbed by construction activities; ▪ Where EVNT flora species are identified targeted species-specific management strategies will be incorporated into project documentation including the EMP and any relevant procedures developed; ▪ All clearing boundaries will be clearly shown on project drawings; ▪ A suitably trained and experienced ecologist will identify and clearly mark hollow-bearing trees, clearing boundaries and vegetation to be retained as construction work moves along the pipeline route; ▪ Physical barriers will be erected around significant vegetation values in order to restrict access and avoid disturbance; ▪ Where the ROW is to be reduced (e.g. sensitive watercourse crossings or sensitive habitat areas) this will be recorded on alignment sheets; ▪ Protected flora species (including terrestrial and marine species) will only

	be removed or disturbed if authorised under a relevant permit;
	▪ Wherever practicable, large riparian trees will be trimmed rather than removed at sensitive watercourse crossings;
	▪ Wherever possible, clearing of remnant vegetation areas should be minimised for the purposes of situating construction camps, laydown areas, vehicle access tracks and other ancillary impact areas;
	▪ Seeds from local tree species will be harvested to assist easement rehabilitation in areas where natural regeneration is not successful;
	▪ To assist in erosion control following construction, cleared native vegetation will be re-spread over the ROW (particularly on the banks of creek crossings and in areas with steep slopes) where safety will not be impaired;
	▪ Specific targeted management measures for rare, endangered or vulnerable species will be implemented including:
	    ▪ If EVNT plants cannot be avoided, an appropriate management plan to offset biodiversity losses will be developed and implemented in liaison with relevant State and Commonwealth regulatory agencies;
	    ▪ Offset management plan to be developed for the Blue grass areas AB35.0 to AB36.5 and AB36.8 to AB37.0
	    ▪ No clearing of brigalow or brigalow regrowth will be conducted outside the ROW.
	▪ Targeted rehabilitation measures will be implemented to restore the ROW to, as far as reasonably practicable, its pre-existing state in terms of biodiversity values.
	Fauna
	▪ A preconstruction ecological survey will be undertaken to identify any EVNT fauna species along the ROW prior to clear and grade;
	▪ Where threatened fauna species are identified, targeted species-specific management strategies will be incorporated into project documentation (including the EMP and any relevant procedures developed);
	▪ Appropriately qualified wildlife spotters / handlers (authorised under a rehabilitation permit issued by DERM) will be on site during clear and grade to rescue and relocate native fauna along the entire route. Searches shall be conducted at least daily, preferably in the morning, to remove animals prior to the heat of the day;
	▪ Ramps (with slopes of no greater than 50%) will be installed in the trench to allow the easy egress of fauna from the trench at a minimum of 1,000 m intervals. In areas of high fauna density, additional ramps and branches shall be installed to enable small fauna to exit the trench, while hessian sacks should be placed at approximately 250 m intervals for animal shelter;
	▪ Where feasible and approved by the landholder, felled timber shall be positioned in small piles along the edge of the ROW to provide habitat for fauna species. Feasibility will depend on the amount of felled timber available, operational and access requirements and the sensitivity of the adjacent vegetation;
	▪ Vehicle tracks along the ROW and designated access areas (turnarounds

	etc) shall be clearly marked and well maintained to minimise the potential for vehicles to stray outside of the ROW, particularly during and after wet weather; ▪ Night caps will be placed over the open pipe string ends to prevent the ingress of wildlife into welded pipes; ▪ The length of time that the trench is open shall be minimised through staging of trenching activities to minimise the potential for the pipeline to impact on local populations of fauna; ▪ Native wildlife trapped in the open trench will be captured by appropriately qualified wildlife spotters / handlers (authorised under a rehabilitation permit issued by DERM) and released to the surrounding environment away from the open trench on a daily basis; and ▪ Rehabilitation efforts will be targeted to protect and enhance flora and fauna habitat values. **Weeds, diseases and pest animal species** ▪ Management strategies will be developed to limit the spread of fauna pest species (e.g. cane toad, fox) along the ROW; ▪ Preconstruction surveys will be undertaken to identify patches of Giant Rats Tail grass along the ROW and access tracks (particularly within the SGIC); ▪ A Weed Management Plan will be developed and implemented throughout the construction phase and operational activities, in consultation with landholders and relevant management authorities; ▪ Weed management procedures will be environmental weeds along the ROW will be sprayed prior to clear and grade, following consultation with respective landholders. This will be undertaken at least two weeks prior to construction work commencing in the respective areas; ▪ Weeds will be destroyed and removed before clearing of the ROW is progressed; ▪ Aquatic weeds will not be transported by tanker or pipelines when transferring water for dust suppression and / or hydro testing; ▪ Landholders and local government will be consulted to identify particular weed management requirements along the ROW; ▪ All vehicles and plant must be certified (with a weed hygiene declaration) that they are weed free prior to their initial commencement of works. ▪ All vehicles and plant should be washed down (as per the Queensland Checklist for Cleandown Procedures 2000) (except as otherwise agreed) prior to moving from weed infested to weed-free sections of the pipeline route; ▪ Stockpiled materials (topsoil, subsoil, rocks) will be reused in the same general area from which they were extracted to avoid spread of weeds, declared plants or plant diseases; and ▪ Monitoring of weed infestations within disturbed areas will occur biannually during construction and then biannually for a period of two years following construction.

	Aquatic ecology ▪ Implementation of a pre-construction survey to identify potential Fitzroy turtle nests and platypus borrows in the sandy areas of the lower Fitzroy catchment and the Isaac River; ▪ No disturbance of sandy substrate during breeding season (September and October) of watercourses that are potential Fitzroy River Turtle habitat; ▪ The ROW for the bed, banks and approaches to watercourses will be minimised as far as practicable and existing access utilised wherever possible; ▪ Where practical, aquatic habitat such as woody snags (if removed) should be reinstated in the watercourse post construction as appropriate; and ▪ Flows will be reinstated at each site as soon as pipe lower-in is completed.
Monitoring	▪ Photographic Records; ▪ Regular inspections undertaken in accordance with the EMP.; and ▪ Offset planting to be monitored for a period of three years following rehabilitation to ensure survival and replacement of mortalities.
Auditing	▪ Regular audits and reviews (non-compliance and incident reporting) undertaken in accordance with the EMP; and ▪ No NCRs and EINs issued in relation to managing clean up and rehabilitation.
Reporting	▪ Daily Check Sheets – completed and reviewed by manager / supervisor; ▪ Complaints Register – recorded and closed out; ▪ Records maintained of all actions and controls; and ▪ Non-compliance and incident reporting undertaken in accordance with the EMP.
Corrective Action	▪ Recommendations and corrective actions implemented.
Responsible Person	▪ Environmental Officer; and ▪ Community Liaison Officer.
Associated Documentation	▪ Alignment Sheet; and ▪ Environmental Line List.

5.7. OPERATIONAL ENVIRONMENTAL MANAGEMENT PLAN

This section describes the environmental objectives and performance criteria for each environmental aspect relevant to the operation of the project. Management strategies to achieve the performance objectives and indicators are also provided. Monitoring requirements, reporting and corrective actions are also briefly outlined for each environmental aspect.

5.7.1. ACCESS AND LANDHOLDER RELATIONSHIPS

Table 5-19: Access and landholder relationships

Element / Issue	To utilise the pipeline easement access track so as to minimise the impact on surrounding vegetation and land use. Liaison with landholders maintained.
Performance Objectives	▪ Minimise disruption to landholder activities; ▪ Maintain regular liaison with landholders along the pipeline route; ▪ Develop relationship with new owners as soon as they are known; and ▪ Reduce the likelihood of the spread of weeds;
Performance Criteria	▪ No justified complaints from landholders; and ▪ Erosion and sediment control in place.
Management Strategies	▪ Utilise pipeline easement access track; ▪ Minimisation of impacts to landholders (e.g. ensure access gates are closed after traversing); ▪ Landholders advised in advance of any maintenance activities on their property; ▪ Maintain regular liaison with landholder and concerns addressed promptly; ▪ Ensure gates are locked where access can be obtained from a road (to ensure unauthorised users are excluded); and ▪ Maintenance of erosion and sediment control measures as required.
Monitoring and Auditing	▪ Regular reviews and audits will be conducted.
Reporting and Corrective Action	▪ Non-compliance and incident reports will be closed out by senior management; and ▪ Complaints Register – recorded and closed out; ▪ Appropriate corrective actions will be implemented.
Associated Documentation	▪ Complaints Register; ▪ Easement inspection check sheet; ▪ Independent audit every two years; and ▪ Annual Return.

5.7.2. FLORA MANAGEMENT

Table 5-20: Flora management

Element / Issue	To promote groundcover and a stable easement.
Performance Objectives	▪ Promote the establishment of ground cover (grass) along the easement; ▪ Remove young tree seedling regrowth from within 3.5 m each side of the pipeline centreline; and ▪ Ensure that weeds are not spread along the easement and declared plants are controlled within the easement.
Performance Criteria	▪ Easement grassed in line with surrounding landscape within 12 months after operations commence; ▪ Seedling regrowth controlled; and ▪ Weeds minimised.
Management Strategies	▪ Promote grass establishment along the easement. This may require spreading native grass seed following rain; ▪ Removal of seedling regrowth as required to comply with the above objective; and ▪ Implementation of an annual program of spraying of weeds along the ROW.
Monitoring and Auditing	▪ Regular reviews and audits will be conducted.
Reporting and Corrective Action	▪ Non-compliance and incident reports will be closed out by senior management; and ▪ Complaints Register – recorded and closed out; ▪ Appropriate corrective actions will be implemented.
Associated Documentation	▪ Complaints Register; ▪ Easement inspection check sheet; ▪ Independent audit every two years; and ▪ Annual Return.

5.7.3. WATERCOURSE MANAGEMENT

Table 5-21: Watercourse management

Element / Issue	To ensure that watercourse crossings are stabilised.
Performance Objectives	▪ Watercourse crossings stabilised; ▪ Minimise erosion and sedimentation; and ▪ Prevent the spread of weeds.
Performance Criteria	▪ Watercourse banks stable; ▪ Erosion and sediment control measures in place and effective; and ▪ Sufficient cover maintained over pipe.
Management Strategies	▪ Watercourse banks are stabilised and contain vegetative cover as necessary to prevent scouring; ▪ Ongoing inspection of watercourses, in particular after flood events, and remedial action will be initiated where required; and ▪ Stormwater diversion banks / drains (whoa-boys) in place and stable.
Monitoring and Auditing	▪ Regular reviews and audits will be conducted.
Reporting and Corrective Action	▪ Non-compliance and incident reports will be closed out by senior management; and ▪ Complaints Register – recorded and closed out; ▪ Appropriate corrective actions will be implemented.
Associated Documentation	▪ Complaints Register; ▪ Easement inspection check sheets; ▪ Independent audit every two years; and ▪ Annual Return.

5.7.4. EROSION AND SEDIMENT CONTROL

Table 5-22: Erosion and sediment control

Element / Issue	To ensure erosion and sediment control measures along the pipeline route are effectively maintained.
Performance Objectives	▪ Minimise soil erosion; ▪ Minimise sedimentation of land; ▪ Minimise modification to drainage patterns; and ▪ Prevent as far as practical, sediment transport to adjacent watercourses.
Performance Criteria	▪ No erosion or sedimentation caused to adjacent land as a result of construction activities; and ▪ No evidence of additional sedimentation in watercourses as a result of erosion from operational activities.
Management Strategies	▪ Inspect the ROW and maintain erosion and sediment controls as necessary to ensure a stabilised easement; ▪ Place additional erosion control structures such as diversion banks / drains (whoa-boys) at key locations if additional erosion is detected along the pipeline; ▪ Divert stormwater away from the pipeline easement if necessary, following consultation with the landholder; ▪ Specific inspection will be carried out after heavy rainfall or flash flooding to ensure that the structural integrity of the pipeline is maintained and re-vegetation is established; and ▪ Replacement of any erosion control measures following any pipeline maintenance or dig-ups.
Monitoring and Auditing	▪ Regular reviews and audits will be conducted.
Reporting and Corrective Action	▪ Non-compliance and incident reports will be closed out by senior management; and ▪ Complaints Register – recorded and closed out; ▪ Appropriate corrective actions will be implemented.
Associated Documentation	▪ Complaints Register; ▪ Easement inspection check sheets; ▪ Independent audit every two years; and ▪ Annual Return.

5.7.5. WASTE MANAGEMENT

Table 5-23: Waste management

Policy	To minimise waste generation and maximise reuse and recycling of waste products.
Performance Objectives	▪ Minimise impacts related to waste management; and ▪ No evidence of litter or refuse generated from maintenance activities.
Performance Criteria	▪ Percentage of waste recycled; and ▪ No litter left on site after maintenance activities.
Management Strategies	▪ Preparation of an Waste Management Plan for operational waste; and ▪ Collection of waste from centralised locations by an approved contractor for recycling, reuse or disposal at approved locations.
Monitoring and Auditing	▪ Regular reviews and audits will be conducted.
Reporting and Corrective Action	▪ Non-compliance and incident reports will be closed out by senior management; and ▪ Complaints Register – recorded and closed out; ▪ Appropriate corrective actions will be implemented.
Associated Documentation	▪ Easement inspection check sheets; ▪ Independent audit every two years; and ▪ Annual Return.

5.7.6. NOISE

Table 5-24: Noise

Element / Issue	To minimise the impact of noise nuisance from pipeline maintenance activities to nearby residents.
Performance Objectives	▪ Minimise noise nuisance generated by maintenance activities.
Performance Criteria	▪ No justified noise-related complaints received from residents.
Management Strategies	▪ Schedule noisy maintenance activities to appropriate times; ▪ Provide advance notice of any scheduled maintenance activities, including venting, to nearby residents; and ▪ Maintain liaison with nearby residents.
Monitoring and Auditing	▪ Regular reviews and audits will be conducted.
Reporting and Corrective Action	▪ Non-compliance and incident reports will be closed out by senior management; and ▪ Complaints Register – recorded and closed out; ▪ Appropriate corrective actions will be implemented.
Associated Documentation	▪ Complaints Register; ▪ Independent audit every two years; and ▪ Annual Return.

5.7.7. HAZARDS AND RISKS

Table 5-25: Hazards and risks

Element / Issue	To ensure that storage and handling of flammable and combustible substances onsite does not cause environmental harm or harm to persons.
Performance Objectives	▪ To minimise potential for land contamination; and ▪ To ensure the on-going safety of operational personnel and the public.
Performance Criteria	▪ Zero incident records.
Management Strategies	▪ An Emergency Response Plan in place and employees inducted in its application; ▪ The outcomes of the Pipeline Safety Management Study will be incorporated into the Safety Operating Plan, as required by AS 2885.3 for the operation of the pipeline. ▪ Flammable and combustible substances are stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS 1940; ▪ Waste flammable and combustible substances which cannot be recycled will be transported to a designated disposal site as approved by Local Government; ▪ Relevant MSDS for all flammable and combustible substances and dangerous goods maintained; ▪ Spill kits containing absorbent containment material (e.g. absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use; ▪ Spills of flammable and combustible substances will be rendered harmless and collected for treatment and / or remediation or disposal at a designated site, including cleaning materials, absorbents and contaminated soils and affected area reinstated; ▪ Personal protective equipment (PPE) appropriate to the materials in use, will be provided; and ▪ Relevant Local Government permits will be held and conditions of permits met.
Monitoring and Auditing	▪ Regular reviews and audits will be conducted.
Reporting and Corrective Action	▪ Non-compliance and incident reports will be closed out by senior management; and ▪ Complaints Register – recorded and closed out; ▪ Appropriate corrective actions will be implemented.
Associated Documentation	▪ Emergency Response Plan; ▪ HSE check list and annual audit; and ▪ Annual Return.

5.8. DECOMMISSIONING PHASE

In the event that the pipeline is no longer required, it will be decommissioned in accordance with the following:

- Moth-balling – this will involve depressurising the pipeline, capping and filling with an inert gas such as nitrogen or water with corrosion inhibiting chemicals. The cathodic protection would be maintained to prevent the pipe corroding; or
- Abandonment – this could involve purging the pipe of natural gas, disconnecting it from the manifolds and removing all above ground facilities. The pipe would then be filled with water and left to corrode in-situ.
- While both decommissioning options associated with decommissioning have potential for small scale localised and temporary environmental impacts, recovering the buried pipe would result in significant and unnecessary environmental impacts. Significant revegetation will have occurred along the operational easement over the life of the project and removing the pipe from the ground is unlikely to be an environmentally- or commercially-viable option. The complexity and cost of removal of the pipe is likely to increase if other pipelines, which may have to be depressurised during the recovery process, cross it and a short length cannot be left in situ. A detailed rehabilitation program would be developed and implemented in consultation with landholders and the Regulator at the time of abandonment.

Removing the pipe from the ground is unlikely to be an environmentally- or commercially-viable option. A detailed rehabilitation program would be developed and implemented in consultation with landholders and the Regulator at the time of abandonment.

Abandonment of the pipeline is unlikely as the pipeline feeds an LNG plant, and can source gas from multiple locations. The pipeline will be subject to ongoing rehabilitation over its planned life, so remediation at any time of abandonment will be minimised.

The above ground facilities associated with this pipeline comprise:

- Main line valves;
- Scraper stations; and.
- GGH

Disposal of materials during decommissioning and rehabilitation will follow the waste management hierarchy. Mainline valves may be re-used, while steel, cabling and some electrical equipment may be suitable for re-cycling. Other materials will be disposed of to appropriate facilities. When the above ground equipment and facilities have been removed, the sites (including access tracks) will be returned to their pre-use state, i.e. open grassed grazing land.

6. COMMITMENTS NOT INCLUDED IN THE EMP

This chapter summarises the commitments made by Arrow within the EIS which are not included in the EMP (**Chapter 5**).

In addition to the broader benefits of the project, Arrow is committed to managing project-specific impacts at a regional and local scale. Arrow has committed to a number of mitigation measures to reduce and manage potential impacts from the project with a net positive effect on environmental, economic and social values. Predicted project benefits are outlined in **Section 2.2.2**. Mitigation measures have been developed to reflect best practice environmental considerations for transmission pipelines that align with regulations and Arrow Energy‘s Environmental Policy, ESD Policy and Management System as presented in the EMP prepared for the project. The mitigation measures have been developed to reflect the outcome of consultation with the landholders and other stakeholders as well as Arrow‘s commitment to ESD.

Key project commitments specific to environmental values assessed throughout the EIS are outlined at the end of each section of the EIS. Additionally, the project EMP sets out the approach to environmental management to be adopted by Arrow in accordance with Section 310D of the EP Act. Commitments not included in the EMP are summarised as follows.

Promoting energy efficiency, water recycling and waste management, while avoiding sensitive vegetation communities, habitat areas and species to the greatest extent possible, will reduce the environmental footprint of the project. Arrow has applied the principles of ESD in the project planning process and in selecting the most appropriate alternatives for the proposed pipeline route.

The project has not yet been referred to the DSEWPAC to determine if it will be a controlled action under the EPBC Act. Referral will be made once the results of ecological surveys have been assessed and potential impacts identified.

Applications for development approvals and permits will be made as required post-EIS determination (refer **Appendix A2**, **Volume 3**).

Undertaking appropriate and effective stakeholder consultation is an essential element of the project. Arrow has developed an SCP which clearly states project stakeholder and community engagement goals, processes and outcomes, and how these will be achieved in a timely and effective manner. Arrow will maintain an active stakeholder liaison program during all phases of the project.

The SIMP drafted to assess and guide the management of social impacts identified through the EIS will be further developed to protect and promote the social values of the community and help build a sustainable relationship between Arrow Energy and all stakeholders in the region.

Arrow is actively negotiating with landholders as described in **Section 1.4** and **Section 4.10**. Negotiations will continue with landholders on issues relating to compensation and terms and conditions of individual land access agreements. This includes any temporary disruption to agricultural production during construction and rehabilitation of the project.

Social sustainability for local communities in the project area will be supported by ongoing communication and consultation about construction and operational activities, land access protocols and environmental management measures. Local labour will be utilised where possible to support the specialist construction crew.

Arrow is exploring the specific significance of the cultural places, object and values identified within the desktop searches and investigations and is committed to finalising field surveys of non-indigenous cultural heritage during 2012.

With regard to indigenous heritage assessments, Arrow is committed to ensuring the direct input of the relevant Aboriginal Parties in a manner that is consistent with the provisions of any Cultural Heritage Agreements.

Arrow intends to develop ILUAs with relevant native title parties along the proposed pipeline route and work on these respective ILUAs is well advanced. CHMPs will be contained in the relevant ILUAs or will be developed separately for approval by DERM to satisfactorily address the cultural heritage interest of the relevant Aboriginal Parties along the proposed pipeline route.

While all practicable efforts will be made to avoid and minimise impacts on flora of high ecological value, it is likely that small areas will be cleared or disturbed for construction and operation of the project. Where residual impacts cannot be avoided, an offset plan will be prepared and implemented to rehabilitate vegetation similar to that of the impacted vegetation in a nearby location. The goal of any offset program will be to achieve a net conservation gain by enhancing the long term sustainability of the vegetation in the Bioregion. Offsets will be developed in liaison with relevant Commonwealth and state regulatory agencies.

Further investigations will be undertaken to develop pipeline route revisions in areas where EVNT species have been recorded. The survey results will be used to refine the proposed pipeline route, more accurately define residual impacts and assist in planning for any requirements for ecological offsets.

Preliminary discussions have been had with SunWater to discuss potential availability of short term allocations to meet the construction pipeline non-potable water requirements. Relevant approvals and water extraction licences will be required for water harvesting along the proposed pipeline route. A Water Options Study will be undertaken to provide greater detail on available sources and facilitate further development of the water resourcing strategy for the project construction phase.

A Pipeline Safety Management Study and Safety Operating Plan will be prepared and subjected to regular compliance audits. These will be updated at intervals not exceeding five years or as required due to a significant change of operating conditions, a change to the state of the knowledge affecting the safety of the pipeline, or relevant legislative requirements. The assessment of hazards and risks associated with the project will progress through to detailed design stage as part of the Pipeline Safety Management Study. Further investigations that will be conducted include:

- Geotechnical studies;
- Proposed land uses potentially impacting on the project, such as mining operations; and
- Potential impacts from third party interference, including mechanical ploughing and consideration of appropriate protection measures.

7. CONCLUSION

The project involves the planning, construction and operation of a buried high-pressure steel transmission pipeline that will deliver gas from Arrow Energy‘s gas fields in the Bowen Basin to Gladstone.

Development of Arrow Energy‘s Bowen Gas Project (including the associated gas processing facilities, compression facilities, water treatment facilities and associated infrastructure) and the development of the Arrow LNG Plant on Curtis Island are subject to separate approval processes and are not part of the project.

The project is important to the economic competitiveness of CSG and, ultimately global distribution of LNG. The project will provide socio-economic benefits to Queensland, contributing to Commonwealth, State and local economies, while recognising the environmental value of the project area, by adding to Queensland‘s long term infrastructure inventory. It will assist Queensland further develop a lucrative export industry by facilitating Queensland‘s expanding LNG industry.

The AB mainline takes a relatively direct route from the proposed starting location near Glenden (approximately 90 km north of Moranbah) to Gladstone before entering the SGIC where it will join the proposed ASP to Gladstone.

The project will provide benefits to the community in terms of income generation and local employment. The transitory workforce will be housed in self-contained temporary workers‘ accommodation camps established for up to four months at any single location and will have limited interaction with the local communities.

The health and safety of the community and project workforce will be given the highest priority during the construction phase and into operations. Safety and health matters during construction and commissioning will be managed through appropriate policies, which will be incorporated in a CSMP and endorsed in the EMP.

The Initial Safety Management Study identified the major general risks associated with the project to be location-specific and unlikely to result in off-site impacts.

Arrow has committed to a range of measures to protect and enhance the natural environment by establishing net positive offset programs for endangered, vulnerable or near threatened flora species identified in the ROW. The project is expected to have negligible impacts on landholders and environmental values

Consultation with landowners and other stakeholders along the route and the field surveys conducted as part of the EIS process assisted Arrow in identifying ecological values and natural features that are regarded as significant or important.

Pipeline alignment planning included an objective to avoid, where possible, areas subject to high landscape character such as significant vegetation to minimise short or long term changes to the existing landscape and particular vistas. The majority of the proposed pipeline route has been selected to follow cleared areas, tracks and previously disturbed areas. Normal land use activities, such as agricultural uses, including cropping and grazing, will continue across the easement following construction and rehabilitation.

The EIS has demonstrated that potential adverse environmental and socio-economic impacts associated with the Arrow Bowen Pipeline project will be mitigated through appropriate alignment and design and managed through the implementation of strategies outlined in the project's management plans.

8. RECOMMENDATION

The potential environmental and socio-economic impacts associated with the project have been assessed against the existing environmental and socio-economic values associated with the project area as outlined in the TOR. Likely impacts have been identified and analysed for conformance with relevant guidelines and standards. Socio-economic benefits have been identified. Mitigation measures are described for the life of the project including construction, operation and decommissioning.

Having regard for the benefits and the impacts of the project as outlined in the EIS, it is recommended that the project proceeds subject to the environmental management plans for construction and operation.

The Chief Executive of DERM is requested to evaluate the EIS and state the conditions under which the project may proceed.

9. REFERENCES

1 – INTRODUCTION

Department of Environment and Resource Management (DERM) (2011). *Curtis Coast Regional Coastal Management Plan*

2 – PROJECT NEED AND ALTERNATIVES

Commonwealth of Australia (2011). *Ecologically Sustainable Development*. Accessed on 22 August 2011 from: http://www.environment.gov.au/about/esd/index.html

Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) (1992). *National Strategy for Ecologically Sustainable Development*. Retrieved on 20 September 2011 from http://www.environment.gov.au/about/esd/publications/strategy/intro.html#GoalsEtc.

Department of Employment, Economic Development and Innovation (DEEDI) (2011). *Blueprint for Queensland's LNG Industry*. Accessed on 23 September 2011 from http://www.industry.qld.gov.au/documents/LNG/Blueprint_for_Queenslands_LNG_Industry.pdf.

3 – DESCRIPTION OF THE PROJECT

AECOM (2011). *Environmental Assessment Report (Flora) for the Proposed Arrow-Bowen Gas Pipeline* 31 October 2011.

APPEA (2011). *CSG Facts: Economic Benefits*. Accessed on 22 August 2011, from: http://www.rlms.com.au/uploaded_docs/CSG_Factsheet_3-Economic%20Benefits.pdf

Arrow Energy (2010a). *Our Company*. Accessed on 20 October 2011, from www.arrowenergy.com.au/page/Our_Company.

Arrow Energy (2011). *Moranbah*. Accessed on 18 August 2011 from http://www.arrowenergy.com.au/page/Projects/Moranbah_Gas_Project/Moranbah.

Arrow Energy (2011a). *Environment*. Accessed on 22 August 2011 from http://www.arrowenergy.com.au/page/Sustainability/Environment/

Commonwealth of Australia (2011). *Ecologically Sustainable Development*. Accessed on 22 August 2011 from: http://www.environment.gov.au/about/esd/index.html

Department of Environment and Resource Management (2011). *Arrow Bowen Pipeline Project*. Accessed on 27 November 2001 from: http://www.derm.qld.gov.au/environmental_management/impact_assessment/eis-processes/arrow_bowen_pipeline_project.html

4.1 – CLIMATE

Attorney General's Department (2011). *Australian Government Emergency Management in Australia*, Viewed August 2011, http://www.ema.gov.au/www/emaweb/rwpattach.nsf/VAP/(084A3429FD57AC0744737F8EA134BACB)~Severe+Thunderstorms+-+facts,+warnings,+protection.pdf/$file/Severe+Thunderstorms+-+facts,+warnings,+protection.pdf Australian Government, 2011

Bureau of Meteorology (BOM) (2011a). *Climatic data for Meteorological Stations 034038 and 039083.* Viewed August 2011, http://www.bom.gov.au/climate/data/ Australian Government

Bureau of Meteorology (BOM) (2011b). *Climate education*. Viewed August 2011, http://www.bom.gov.au/lam/climate/levelthree/c20thc/qld.htm Australian Government

Bureau of Meteorology (BOM) (2011c). *Tropical Cyclones in Queensland.* http://reg.bom.gov.au/cyclone/about/eastern.shtml Viewed August 2011, Australian Government

Bureau of Meteorology (BOM) (2008). *An Assessment of the Impact of Climate Change on the Nature and Frequency of Exceptional Climatic Events*. Australian Government

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BOM) (2007). Technical Report, Climate Change in Australia

Department of Employment, Economic Development and Innovation (DEEDI) (2011). *Drought Situation Reports,* Viewed August 2011, http://www.longpaddock.qld.gov.au/queenslanddroughtmonitor/queenslanddroughtreport/index.php Queensland Government, 2011

International Erosion Control Association (2008). *Best Practice Erosion & Sediment Control*, Picton NSW, November 2008.

Queensland Floods Commission of Inquiry (2011). *Interim Report*. Queensland Government, August 2011

Queensland Fire and Rescue Service. *Bushfire risk maps*. Viewed August 2011, http://www.ruralfire.qld.gov.au/Bushfire%20Planning/Building%20in%20Bushfire%20Prone%20Areas/ Queensland Government

4.2 – LAND

AECOM (2011). Environmen*tal Assessment Report (Flora) for the Proposed Arrow Bowen Gas Pipeline*, 31 October 2011

Arrow Energy (2011). *Draft Native Title Report – Arrow Bowen Pipeline EIS*. August 2011.

Arup (2011). Arrow Bowen Pipeline – Phase 2 Geotechnical Study, Volume 1, September 2011.

Central Queensland Cultural Heritage Management Pty Ltd (CQCHM) (2011). *Cultural Heritage Impact Assessment - Arrow Bowen Pipeline EIS*.

Commonwealth of Australia (Geosciences Australia) (2011). *Earthquake Database*. Accessed on 28 September 2011 from http://www.ga.gov.au/earthquakes/searchQuake.do

Department of Defence (2011). *UXO Contamination Sites*. Accessed on 30 September 2011 from http://www.defence.gov.au/uxo/where_is_uxo/where_is_uxo.asp

Department of Environment and Resource Management (DERM). (2011). *Contaminated Land*. Accessed on 30 September 2011 from http://www.derm.qld.gov.au/environmental_management/land/contaminated_land/index.html

Department of Environment and Resource Management (DERM) (2010). *Banana Region, Central Western Region, South West Region and North Qld Good Quality Agricultural Land Datasets.*

Department of Environment and Resource Management (DERM) (2005). *Queensland Land Use Mapping Program*. 1 April 2005.

Dickins, J. M. and Malone, E. J. (1973). *Geology of the Bowen Basin*. Queensland.

ECOSM (2011), *Arrow Bowen Pipeline Terrestrial Fauna Assessment*.

4.3 – TRANSPORT

GHD (2011). *ABP Traffic Impact Assessment*. Arrow Energy.

4.4 – WASTE

APIA (2009) *Australian Pipeline Industry Association Code of Environmental Practice – Onshore Pipelines, Canberra*. Available at www.apia.net.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=E1852275-1C23-CACD-2205-A4BB841B2A9C&siteName=apia, March 2009

Department of Environment and Resource Management (DERM) (2010). *Queensland's Waste Reduction and Recycling Strategy 2010-2020*

4.5 – WATER RESOURCES

AECOM (2011). *Water Crossing Information for Arrow-Bowen Gas Pipeline*. 3 November 2011.

ANZECC (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. October 2000

Australian Pipeline Industry Association (APIA) (2009). *Code of Environmental Practice – Onshore Pipelines*

Department of Environment and Resource Management (DERM) 2009. *Queensland Water Quality Guidelines.* Version 3 ISBN 978-0-9806986-0-2.

Department of Environment and Resource Management (DERM) 2010. Establishing Environmental Values, Water Quality Guidelines and Water Quality Objectives for Fitzroy Basin Waters – Draft for Consultation

Department of Environment and Resource Management (DERM) 2011. Guideline - Establishing Draft Environmental Values, Management Goals and Water Quality Objectives

GHD (2011). Arrow Energy Major Pipelines Water Availability Study. September 2011

4.6 – AIR

Australian Pipeline Industry Association Ltd (APIA) (2009). *Code of Environmental Practice – Onshore Pipelines*. March 2009. Accessed on 5 September 2011 from: http://www.apia.net.au

Bureau of Meteorology (BoM) (2011). *Climate averages*. Accessed on 5 September 2011 from the Bureau of Meteorology website www.bom.gov.au.

Department of Climate Change and Energy Efficiency (DCCEE). (2010). *State and Territory Greenhouse Gas Inventories,* May 2010.

Department of Climate Change and Energy Efficiency (DCCEE) (2011). *National Greenhouse Accounts (NGA) Factors*. Canberra, July 2011.

Department of Environment and Resource Management (DERM) (2006). *Air monitoring report*. Queensland 2005.

Department of Environment and Resource Management (DERM) (2007). *Air monitoring report*. Queensland 2006.

Department of Environment and Resource Management (DERM) (2008). *Air monitoring report*. Queensland 2007.

Department of Environment and Resource Management (DERM) (2009). *Air monitoring report*. Queensland 2008.

Department of Environment and Resource Management (DERM) (2010). *Air monitoring report*. Queensland 2009.

4.7 – NOISE AND VIBRATION

Environmental Protection Agency (EPA) (2004), *Guideline: Noise and vibration from blasting,* Environmental Protection Agency, Brisbane.

Larkin, R.P., L.L. Pater, and D.J. Tazik (1996). *Effects of military noise on wildlife: A literature review*. USACERL Technical Report 96/21, January 1996

4.8 – ECOLOGY

AECOM. (2011a). *Environmental Assessment Report (Flora) for the Proposed Arrow Bowen Gas Pipeline*. 31 October 2011.

AECOM (2011b) *Water Crossing Information for Arrow Bowen Gas Pipeline*. 4 November 2011

Australasian Reptile & Amphibian Specialist Group (1996). *Rheodytes leukops*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.1. <www.iucnredlist.org>. Accessed 08 September 2011.

Department of Environment and Resource Management (DERM) (2009). *Queensland Wetland Mapping and Classification for the whole state*, 2005 extent Version 2.0, Department of Environment and Resource Management, Queensland Government, Brisbane.

Department of Environment and Resource Management (DERM) (2011), *Wildlife Online Extract*. http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/wildlife_online.

ECOSM (2011). *Arrow Bowen Pipeline Terrestrial Fauna Assessment*. October 2011.

Inglis, S.N. and Howell, S. (2009). *Aquatic Conservation Assessments, using AquaBAMM, for the riverine wetlands of the Great Barrier Reef catchment*. Department of Environment and Resource Management, Brisbane.

Serena, M., Thomas, J.L., Williams, G.A. & Officer, R.C.E., (1998). Use of stream and river habitats by the platypus (Ornithorhynchus anatinus) in an urban fringe environment. Australian Journal of Zoology 47:117-131

SKM (2011). *Aquatic Ecology Assessment*. October 2011.

4.9 – CULTURAL HERITAGE

Alfredson, G. (1989). *Report on Initial Archaeological Survey of the Stuart Oil Shale Project.* Report prepared for Hollingsworth Consultants Pty Ltd

Alfredson, G. (1992). *Gladstone Industrial Land Project Studies: Archaeology and Heritage Survey, Stage 2*. Unpublished Report

Archaeo Cultural Heritage Services (2006). *Cultural Heritage Survey for the proposed Moranbah-Gladstone Gas Pipeline; Gladstone Section*. Report prepared for Enertrade Pty Ltd.

Archaeo Cultural Heritage Services (2007). G*ladstone Pacific Nickel Project: Cultural Heritage Survey*. Reports prepared for Gladstone Pacific Nickel Pty Ltd.

Central Queensland Cultural Heritage Management Pty Ltd (CQCHM). (2011). *Cultural Heritage Impact Assessment for Arrow Bowen Pipeline*.

Hall, H. J. (1980). *An Archaeological Assessment of the Alcan Smelter Site, Gladstone, Queensland*. Report prepared for James B. Croft and Associates, Sydney.

Hall, H. J. (1981). *An Archaeological Assessment of the Lend Lease Corp. Coke Plant near Gladstone, Queensland*. Report prepared for Oceanics Australia Pty Ltd.

ICOMOS (1999) *The Burra Charter - The Australia ICOMOS Charter for Places of Cultural Significance (and associated Guidelines).* Accessed 14 September 2011 http://australia.icomos.org/publications/charters/

4.10 – SOCIAL

Australian Bureau of Statistics (ABS) (2006). *Census of Population and Housing*.

GHD (2011). *ABP Transport Impact Assessment.*

Real Estate Institute of Queensland (2011). *Queensland Market Monitor: Issue 9*

4.11 – HEALTH AND SAFETY

Arrow Energy (2011) *Safety: Arrow LNG Plant*

Arrow Energy (2011) *Arrow Energy Pipeline Project, Initial Advice Statement*

Department of Community Safety. (2011). *Queensland Ambulance Service, Central Region.* Accessed on 29 September 2001 from http://www.ambulance.qld.gov.au/central/

GHD (2011) *Arrow Energy Major Pipelines: Water Availability Study,* September 2011

4.12 – ECONOMY

Gladstone Ports Corporation (2011) *About GPC*, Gladstone Ports Corporation Ltd, http://www.gpcl.com.au/AboutGPC/AboutGPC.aspx

4.13 – HAZARD AND RISK

Arup Pty Ltd. (2011). *Arrow Bowen Pipeline Phase 2 Geotechnical* Study. Volume 1, September, 2011.

Australian Pipeline Industry Association (APIA). (2009). *Code of Environmental Practice – Onshore Pipelines.* Canberra

Bureau of Meteorology (BoM) (2011). Flood warning system for the Fitzroy River. Viewed August 2011, http://www.bom.gov.au/hydro/flood/qld/brochures/fitzroy/fitzroy.shtml Australian Government

CGIAR-CSI (2006). *NASA Shuttle Radar Topographic Mission (SRTM)*. Viewed August 2011, http://srtm.csi.cgiar.org/

GHD (2011). *Initial Safety Management Study for Arrow Bowen Pipeline*

Queensland Fire and Rescue Service (QFRS) (2011). *Bushfire Risk Analysis Mapping*. Viewed August 2011, http://www.ruralfire.qld.gov.au/Bushfire%20Planning/

Queensland University Advanced Centre for Earthquake Studies (2011). *Earthquake information for Queensland.* Viewed August 2011, http://www.quakes.uq.edu.au/html/quake_info/OZ_QLD_info.html

5 – EMP

Arrow Energy (2011). *Environmental Policy*. Accessed August 2011. http://www.arrowenergy.com.au/icms_docs/96831_Arrow_Environmental_Policy.pdf

Australian Pipeline Industry Association (APIA) (2009). *Australian Pipeline Industry Association Code of Environmental Practice – Onshore Pipelines,* Canberra.

Find out more online at
www.arrowenergy.com.au
BRISBANE DALBY MORANBAH GLADSTONE

Arrow Bowen Pipeline Pty Ltd
ACN: 141 181 295

RECYCLED CONTENT

This folder is printed on paper containing recycled content.

arrow energy
go further