Australia Pacific LNG Project

Volume 2: Gas Fields

Chapter 16: Waste

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16.1 Introduction

Australia Pacific LNG proposes to develop a world scale long term coal seam gas (CSG) to liquefied natural gas (LNG) project in south central Queensland. The Australia Pacific LNG Project (the Project) is expected to be over a 30 year period and will include:

- Development of the Walloons gas fields in the Surat Basin in southern central Queensland with up to 10,000 coal seam gas wells
- Construction and operation of a 450km main gas transmission pipeline (the gas pipeline) to connect the Walloons gas fields with the LNG facility near Laird Point
- Construction and operation of an LNG facility near Laird Point on Curtis Island near Gladstone for production and export of approximately 18 million tonnes per annum (Mtpa) of LNG.

16.1.1 Purpose

This environmental impact statement (EIS) chapter assesses the waste from the gas fields, while Volume 3 Chapter 16 and Volume 4 Chapter 16 assess the gas pipeline and LNG facility wastes respectively.

Throughout the Project's life, including site preparation, construction, operation, decommissioning and rehabilitation, it will produce a variety of waste streams and products. Australia Pacific LNG has a strong commitment to sustainability and has developed a set of sustainability principles that will be used to guide the management of waste. Volume 1 Chapter 3 discusses sustainability for the Project in more detail.

Of Australia Pacific LNG's 12 sustainability principles, key relevant principles for waste management are:

- Minimising adverse environmental impacts and enhancing environmental benefits associated with Australia Pacific LNG's activities, products or services; conserving, protecting, and enhancing where the opportunity exists, the biodiversity values and water resources in its operational areas
- Using resources efficiently, reducing the intensity of materials used and implementing programs for the reduction and re-use of waste
- Identifying, assessing, managing, monitoring and reviewing risks to its workforce, Australia Pacific LNG's property, the environment and the communities affected by its activities
- Working cooperatively with communities, governments and other stakeholders to achieve positive social and environmental outcomes, seeking partnership approaches where appropriate.

In applying the sustainability principles, Australia Pacific LNG will develop and implement waste management guidelines. The guidelines will incorporate the waste management hierarchy to avoid, reduce, recycle and dispose of wastes.

16.1.2 Scope of work

This chapter identifies the likely waste streams generated through the construction, operation, decommissioning and rehabilitation of the gas fields. It assesses the potential impacts on the surrounding environment from the generated wastes and proposes management strategies to minimise the impact.

Further information regarding waste streams generation and management for the gas fields are discussed in the following EIS chapters:

- Air emissions– Volume 2 Chapter 13
- Associated water – Volume 2 Chapter 12
- Brine – Volume 2 Chapter 12
- Stormwater – Volume 2 Chapter 11
- Hydrotest water – Volume 2 Chapter 11.

16.1.3 Legislative and policy framework

Queensland's waste management regulatory requirements are provided within the *Environmental Protection Act 1994*, the Environmental Protection Regulation 2008, the Environmental Protection (Waste Management) Policy 2000, and the Environmental Protection (Waste Management) Regulation 2000.

Environmental Protection Act 1994

The objective of the *Environmental Protection Act 1994* is to protect Queensland's environment while allowing for 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 (ecologically sustainable development).

The Act defines waste as anything, that is:

- Left over or an unwanted by-product from an industrial, commercial, domestic or other activity
- Surplus to the industrial, commercial, domestic or other activity generating the waste.

Environmental Protection Regulation 2008

The Environmental Protection Regulation 2008 defines 'general waste' as waste other than regulated waste. Regulated waste is defined as waste that is:

- A commercial or industrial waste, whether or not it has been immobilised or treated.
- Of a type, or contains a constituent of a type, mentioned in schedule 7 of the Regulation.

Environmental Protection (Waste Management) Policy 2000

The aim of the Environmental Protection (Waste Management) Policy 2000 is to achieve the objective of the *Environmental Protection Act 1994* in relation to waste management through:

- Identifying the environmental values to be enhanced or protected
- Providing a framework to:
  - Ensure waste management is consistent with ecologically sustainable development

  - Minimise the impact of waste on the environment
  - Minimise the quantity of waste generated
  - Promote efficient use of resources and maximum use of waste
  - Continuously improve waste management activities
- Providing for the preparation of waste management programs and industry waste reduction programs.

The Environmental Protection (Waste Management) Policy 2000 outlines the waste management hierarchy as an optimal waste management tool, which moves from most preferred to least preferred:

- Waste avoidance
- Waste re-use
- Waste recycling
- Energy recovery
- Waste disposal.

One of the principles highlighted in the Policy applicable to the management of wastes associated with the Project is the 'polluter-pays principle'. This principle states 'all costs associated with the management of waste should, if practicable, be borne by the persons who generated the waste'.

The waste management hierarchy and the 'polluter pays principle' have important ramifications for the design of a waste management program. The waste hierarchy is specifically designed to reduce the amount of waste a project produces; while the polluter pays principle encourages 'cleaner/greener' design by the proponent, by ensuring they are held accountable for any wastes the Project may produce.

The environmental values which have the potential to be impacted by waste are:

- Life, health and wellbeing of people
- Diversity of ecological processes and associated ecosystems
- Land use capability, having regard to economic considerations
- Management of finite resources.

The management of waste must protect these values during the construction, operation, decommissioning and rehabilitation of the gas fields.

Environmental Protection (Waste Management) Regulation 2000

The object of Environmental Protection (Waste Management) Regulation 2000 is to protect the environment by:

- Minimising the impact of waste on the environment including, in particular, the impact of waste so far as it directly affects human health
- Establishing an integrated framework for minimising and managing waste under the principles of ecologically sustainable development.

The regulation also provides the reporting and tracking requirements for regulated waste.

Australia Pacific LNG corporate standards

Origin Energy (Origin) will develop and operate the gas fields on behalf of Australia Pacific LNG. As a result, waste management for the gas fields will also be in accordance with Origin's Health, Safety and Environment Management System Standard 19: Product Stewardship, Conservation and Waste Management.

This standard aims to minimise the consumption of resources and materials as far as reasonably practicable. Wastes are to be eliminated, reduced, recycled and/or re-used as far as reasonably practicable or disposed of appropriately.

The following performance requirements will be implemented:

- Development and implementation of programs to ensure wastes are eliminated, reduced, re-used, recycled, treated and/or appropriately disposed of as a last resort
- Development and implementation of systems to identify, quantify, and monitor wastes generated. Records will be kept to ensure wastes can be tracked from source to disposal, and waste receiving facilities are pre qualified and if necessary audited to ensure conformance to appropriate waste standards.

16.2 Methodology

Wastes were identified for the construction, operation, decommissioning and rehabilitation of the gas fields. These were categorised into general waste, recyclable and regulated waste and management options were identified using the principles of the waste management hierarchy and cleaner production initiatives. Quantities of wastes were identified using data compiled from existing Origin operations, and other similar coal seam gas projects.

The matrix shown in Section 16.5.10 was developed to further investigate the likely impacts associated with each identified waste. Management options for these were then identified, employing principles such as the waste management hierarchy which focuses firstly upon avoidance and minimisation, and secondly reuse and recycle, and finally disposal.

16.3 Waste generation

16.3.1 Construction waste

Waste will be generated through the construction of gas wells, gas and water gathering networks, high pressure gas pipelines, gas processing facilities (GPF), water treatment facilities (WTF), water transfer stations, brine ponds and associated infrastructure. The major waste streams generated during the construction phase include:

- Green waste
- Construction materials including pipe off-cuts, concrete rubble, timber
- Drilling fluids and cuttings
- Waste oils, oily rags and empty oil containers
- Used chemicals and empty chemical/paint/solvent containers
- General waste including putrescible waste
- Paper and cardboard

- Greywater and sewage
- Stormwater
- Hydrotest water
- Air emissions.

The temporary accommodation facilities will generate general waste, sewage, greywater and cooking waste oils. Section 16.3.4 details the storage and treatment of sewage and greywater. The remaining wastes from the temporary accommodation facilities will be segregated and appropriately stored in designated waste management areas prior to transport off-site to a suitable recycling facility or landfill. Refer to Section 16.5.5 for details on local landfills and Section 16.5.6 for waste handling and storage.

Wastes from the construction of the gas wells will primarily be drilling fluids and cuttings as a result of drilling activities. The drilling fluids and cuttings are typically inert and will be stored within sumps located on the drill pad. Once drilling is complete, the sumps are left to settle out. The water is typically pumped out and transported to the feed ponds at the WTFs and the solids are mixed with subsoil, buried, covered and rehabilitated.

Construction of the gas and water gathering network and high pressure gas pipelines will generate relatively minor quantities of wastes. Green waste and spoil material will be re-used onsite during rehabilitation and high density polyethylene, steel pipe offcuts, packaging and general waste will be transported to the nearest GPF waste management area for segregation, storage and transport off-site by a licensed waste contractor.

GPFs and WTFs will generate a wide range of wastes including construction materials (pipe offcuts, concrete, and timber), waste oils and chemicals and their associated containers, general and putrescible waste, sewage and greywater. Designated waste management areas within each GPF will contain skips and bins which will be colour coded to maximise waste segregation. Larger waste items (including steel and timber) will be stored within designated sections of the area. Refer to Section 16.5.6 for waste handling and storage.

Each major facility will be a self-contained entity including stormwater diversion drainage systems, runoff treatment via oily water capture and processing for skid-mounted equipment, and first-flush sediment ponds used for other parts of these facilities. Refer to Section 16.3.4 and Volume 2 Chapter 11 for further details on stormwater.

Air emissions generated during construction activities are likely to consist of engine exhausts from vehicles and diesel generators and from dust generated by earthworks and vehicle movements on sealed and unsealed roads. The composition of engine exhaust emissions is expected to be primarily nitrogen oxides (NO_X) and carbon monoxide (CO) with small quantities of hydrocarbons. Refer to Volume 2 Chapter 13 for details on air emissions.

Following the construction of a section of high pressure pipeline, hydrostatically pressure testing (hydrotesting) will be conducted. The resulting hydrotest water will be tested for discharge criteria prior to release. Refer to Volume 2 Chapter 11 for details on hydrotest water disposal.

Section 16.5.10 provides a detailed inventory of waste generated during the construction phase, potential impacts and management strategies to minimise the waste produced, maximise re-use and recycling and minimise impacts to the environment.

16.3.2 Operational waste

Waste will be generated during the operation of wells, GPFs, WTFs, brine ponds and associated infrastructure. The major waste streams generated during the operational phase are:

- Associated water
- Brine from the WTF
- Poly pipe and scrap metal
- Waste oils and chemicals
- Batteries
- Filters
- Greywater and sewage
- General waste including putrescible waste
- Stormwater
- Air emissions.

Associated water is the main waste generated during the operational phase. It is produced at the well head, separated from the gas stream and transported to the WTF for treatment. The associated water and brine are discussed in Section 16.5.6 and Volume 2 Chapter 12.

Operation of the GPFs and WTFs will generate a wide range of wastes including waste oils, coolant, sump fluids, contaminated material, general maintenance waste, paper and cardboard. The waste management area within each GPF and WTF will contain skips and/or bins which will be colour coded to maximise waste segregation. Larger waste items (including steel and timber) will be stored within designated sections of the waste management area. Wastes will be transported off-site to a suitable recycling facility or landfill by a licensed contractor. Refer to Section 16.5.6 for details on waste handling and storage.

Each major facility will be a self-contained entity including stormwater diversion drainage systems, runoff treatment via oily water separator and processing for skid-mounted equipment, and first-flush sediment ponds used for other parts of these facilities. Refer to Section 16.3.4 and Volume 2 Chapter 11 for further details on stormwater.

The permanent accommodation facilities will generate general waste, sewage, greywater and cooking waste oils. Section 16.3.4 details the storage and treatment of sewage and greywater. The remaining wastes from the permanent accommodation facilities will be segregated and appropriately stored in designated waste management areas prior to transport off-site to a suitable recycling facility or landfill by a licensed waste contractor. Refer to Section 16.5.5 for details on local landfills.

The following key air pollutants are likely to be emitted within the Project's gas fields:

- NO_X as nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- CO
- Particulate matter with an aerodynamic diameter less than ten microns (PM_{10})
- Hydrocarbons.

Refer to Volume 2 Chapter 13 for more information on air emissions.

Section 16.5.10 provides a detailed inventory of waste generated during the operational phase, potential impacts and management strategies to minimise the waste produced, maximise re-use and recycling and minimise impacts to the environment.

16.3.3 Decommissioning and rehabilitation waste

General and regulated wastes will be produced during the decommissioning and rehabilitation of the gas fields. The Project is in the early phases of development and has yet to complete a detailed assessment of the type and quantity of waste generated during this phase of the Project. However, it can be expected that all aboveground facilities and equipment will be dismantled and removed. Where feasible, the following material and equipment will be re-used:

- Process and chemical pumps
- Aboveground storage tanks
- Compressors and process equipment
- Gas and diesel engine power generators
- Demountable and modular buildings.

The material and equipment likely to be suitable for recycling or re-use includes:

- Building steel frames and cladding
- Electrical switchgear
- Control systems equipment
- Above ground pipelines, flow-lines and manifolds
- Separators, deconstructed above ground storage tanks
- Fencing and miscellaneous steelwork
- Electrical cable.

The material and equipment likely to be unsuitable for either re-use or recycling includes:

- Plastic and glass fibre reinforced plastic pipe work and tanks
- Sludge from pipelines and equipment.

Further assessment of the decommissioning and rehabilitation wastes will be undertaken in accordance with Origin's standards and procedures and statutory requirements.

16.3.4 Stormwater and effluent

Sewage will be generated throughout all phases of the Project. Package sewage treatment facilities will be located at each of the temporary and permanent accommodation facilities, GPFs and WTFs to treat the generated sewage. The treatment facilities will be designed to treat the waste to Class C recycled wastewater quality to permit disposal to land without impacting on the environment including surface water and groundwater. Table 16.1 details the contaminant levels required for disposal. The volume of sewage to be produced is an estimated 150L per person per day.

Table 16.1 Class C wastewater quality

Quality characteristics	Units	Limit
Biological oxygen demand (BOD)	mg/L	20 (maximum)
pH	Scale	6.0 – 8.5
Electrical conductivity	µs/cm	<1,600
Total dissolved solids	mg/L	<1,000
Total suspended solids	mg/L	30 (maximum)
Escherichia coli (E. coli)	Colony forming units/100mL	<1,000 (maximum)
Total nitrogen	mg/L	35 (maximum)
Total phosphorous	mg/L	10 (maximum)
Dissolved oxygen	mg/L	2 (maximum)

A typical sewerage treatment plant will include:

- A balance tank for flow equalisation
- A primary tank for settlement, digestion storage of solid matter
- An aeration compartment for biological degradation of organic matter
- A clarifier for further removal of residual suspended solids
- A final effluent tank for disinfection and storage of treated water.

Absorption beds and/or irrigation fields will be used for treated wastewater disposal and will be located and designed to avoid:

- Sensitive areas
- Soil erosion
- Surface ponding
- Impact on the quality of ground water.

Signs will be erected around absorption beds and/or irrigation fields to restrict access.

The resultant sludge will be transported off-site by a regulated waste contractor to a regulated waste facility.

The treatment facilities will be designed to include alternative storage and disposal options during times of system failure and in conditions preventing discharge to land (that is during rain events).

Sewage from small accommodation facilities such as drilling rigs and advance accommodation facilities will be disposed of onsite in an appropriate manner.

Stormwater is generally not considered a waste unless it becomes contaminated in a construction or process area. Stormwater will be generated throughout the construction and operational phases of the Project. GPFs and WTFs form impervious areas which will result in an increased volume of runoff and rate and could be contaminated with hydrocarbons and sediments. Each major facility will be a self-contained entity including stormwater diversion drainage systems, runoff treatment via oily water

capture and processing for skid-mounted equipment, and first-flush sediment ponds used for other parts of these facilities.

Where required, oily wastewater will be processed through an oily water separator. The separated oil will be collected and transported to a regulated facility. Water will be stored in the facility surface water retention pond which will be assessed for surface water discharge criteria prior to release.

Refer to Volume 2 Chapter 11 for further details on the potential impacts and mitigation measures for stormwater.

16.4 Potential impacts

Environmental impacts from waste will only occur as a result of poor management. The potential impacts include the following:

- Land and water (surface water and groundwater) contamination from inappropriate storage, handling and disposal of solid and liquid wastes
- Land and water (surface water and groundwater) contamination from spills during handling and transportation
- Land and water contamination (surface water and groundwater) from spills/overflows from extreme rainfall events
- Increased populations of vermin from inappropriate storage and handling of waste
- Visual amenity impacts due to poor housekeeping
- Inefficient use of resources
- Adverse effects to flora and fauna.

Section 16.5.10 provides a detailed inventory of waste generated during the construction and operational phases, potential impacts from each of the identified waste streams and management strategies to minimise impacts to the environment.

Wastes are not expected to pose a significant risk to the environment or public health with the implementation of effective waste management and control measures. Refer to Section 16.5.10 for residual risk levels.

16.5 Mitigation and management

The main objective of waste management is to minimise impacts to the environmental values as outlined in Section 16.1.3 and to implement the sustainability principles. Several strategies will be used for the Project, principally the implementation of the waste management hierarchy and cleaner production principles. These are discussed in further detail in Sections 16.5.3 and 16.5.4 respectively.

The waste management and minimisation actions proposed for the gas fields are detailed in this section, Section 16.5.10 and in the environmental management plan (EM Plan) in Volume 2 Chapter 24. The table details the key initiatives that have been incorporated for each waste stream to ensure it is managed sustainably.

16.5.1 Waste management guidelines

Detailed waste management guidelines will be developed for the construction, operation, decommissioning and rehabilitation phases of the Project. They will aim to minimise the consumption

of resources, reduce the quantity of waste produced, maximise waste reuse and recycling opportunities, minimise the risk to the employees, environment and communities from generated wastes and effectively implement the principles of the waste management hierarchy.

The plans will include the following details:

- Waste streams and quantities
- Management strategies to be employed for each waste stream
- Roles and responsibilities
- Monitoring waste streams and management activities
- Spill incident and response
- Auditing against the waste management guidelines
- Reporting requirements.

The framework for waste management guidelines will involve working the following waste management high level strategies detailed in this chapter, and progressing these into functional waste management guidelines. The waste management guidelines will be a dynamic document to be amended specifically for each phase of the gas fields and updated subsequent to waste management audits to ensure continual improvement.

16.5.2 Summary of key environmental design features

The following is a summary of the key environmental design features incorporated in the design of the gas fields.

Liquid waste minimisation

The gas fields will use a variety of technologies and practices to control and minimise liquid wastes. Where practicable, these measures will include:

- Segregation of wastewater streams and their treatment (contaminated stormwater, wastewater and associated water)
- Re-use of treated wastewater for onsite irrigation
- Use of secondary containment structures for storage of hazardous liquid wastes
- Design the facilities to Australian Standards for the storage and handling of dangerous goods such as fuels and chemicals
- Re-use of hydrotest water
- Beneficial reuse of permeate water for agricultural use (preferred initial case), industrial use, potable water supply, or injection into aquifers
- Investigate re-use of drilling mud.

Solid waste minimisation

The gas fields will use of a variety of technologies and practices to control, minimise, and re-use solid wastes during construction and operation. Where practicable, these measures will include:

- Maximise recycling and re-use opportunities

- The re-use of cleared site vegetation (including mulching) to aid site rehabilitation and erosion and sediment control following site earthworks
- Develop contract conditions with suppliers to minimise waste entering the gas field sites
- Beneficial re-use of brine including; producing potentially saleable salt products and implementing salt crystallisation.

Air emissions minimisation

The gas fields will use a variety of technologies and practices to minimise and control air emissions during construction and operation. Where practicable, these measures will include:

- Vehicles and machinery used in the construction of the gas fields will be fitted with appropriate emission control equipment and maintained in a proper and efficient manner in accordance with the manufacturer's specifications
- Alternative low emission technologies will be investigated as appropriate including electric drive motors
- Lean-burn gas-fired engines with lower NO_X emissions will be used wherever practicable
- Venting of gas at wellheads will be restricted to emergency situations and periodic maintenance activities
- Flaring at GPFs will be minimised by implementing suitable control strategies
- Dust mitigation measures will be implemented including
  - Minimising disturbance footprint
  - Minimising duration of disturbance
  - Use of dust suppression methods including watering.

16.5.3 Waste management hierarchy

The waste management hierarchy will be the primary tool used in the gas fields for sustainable waste management.

Waste avoidance

Waste avoidance will be achieved through the consideration of alternative products, implementation of alternative technology and procurement processes which includes the provision of contracts with companies encouraging sustainable waste management practices.

The use of pre-fabricated materials will play an important part in waste avoidance for the gas fields. Given the remote location, a number of prefabricated/modular components will be sourced and brought onto site for the GPF, WTFs and well surface facilities. This will substantially reduce the quantities of some waste streams associated with the construction phase, including scrap steel and surplus concrete.

Waste re-use

The re-use of waste will be achieved through identifying re-use opportunities onsite and subsequently identifying market demands for waste items. To maximise re-use opportunities wastes will be

segregated. Waste items will be generated by the Project and may be re-used include timber pallets and scrap metal.

Future investigations regarding waste re-use will continue. Additionally, the marketability of wastes will be regularly reviewed to ensure potential new and emerging opportunities for waste re-use are maximised.

Waste recycling

Waste recycling will be a large component of the waste management strategy used onsite. A large percentage of the waste generated through the Project can be recycled including:

- Waste oils
- Construction materials including pipe off-cuts, timber
- Scrap ferrous and non-ferrous metal
- Welding consumables
- Paper and cardboard, glass, some plastics, tins and cans
- Poly pipe

Australia Pacific LNG will encourage local businesses to take advantage of opportunities for re-use and recycling, if available or initiate opportunities, if unavailable

Regulated waste which can be recycled will be transported off-site by a licensed contractor to an appropriate recycling facility.

Table 16.2 provides an outline of the recyclable product, potential end use and a qualitative assessment of the marketability of the product.

Table 16.2 Recyclables and market potential

Recyclable product	Potential end use	Marketability
Scrap ferrous metal	Scrap metal will be managed via a third party licensed recycling contractor. The product will be removed from the site, shredded and either re-smelted or used in the smelting process. Any grade of steel can be recycled to top quality new metal.	High marketability with continual high demand from local and global market available
Scrap non-ferrous metal	Scrap metal will be managed via a third party licensed recycling contractor. The product will be removed from the site, shredded and crushed into bales for resale. It is then smeltered to produce a molten product and forged. There is very little property differences between recycled and virgin non ferrous metal.	High marketability with continual high demand from the local and global market
Lead acid batteries	Batteries will be managed via a third party licensed recycling contractor. The lead acid batteries will be removed from the site and striped with workable components recycled into new batteries.	High marketability with Queensland markets available to recycle this waste.

Recyclable product	Potential end use	Marketability
Paper, cardboard, glass, some plastics, tins and cans	These recyclable wastes will be managed via a third party licensed recycling contractor. The products will be removed from site and taken to a material recovery facility to sort to specifications, baled, shredded, crushed, or otherwise prepared for resale.	Medium marketability as the demand from Australian and global markets for these products are unstable and will fluctuate.
Waste oils	Waste oils will be managed via a third party licensed recycling contractor. The oils will be taken from the site, filtered and demineralised, propane de-asphalted and distilled to produce re-refined base oil suitable for use as a lubricant, hydraulic or transformer oil.	High marketability with Queensland markets available to recycle this waste.
Decommissioning equipment	A decommissioning plan will be developed that will maximise recycling opportunities. Ferrous metals and non-ferrous metals will be managed as above. Plant and equipment will be sold.	Medium to high marketability due to high value recyclable materials generated.

Waste disposal

Disposal of wastes will only be used where there is no other option available. General waste will be transported to a local landfill for disposal in accordance with regulatory requirements. Regulated waste will be transported off-site by a licensed contractor to an appropriate regulated waste facility. Refer to Section 16.5.5 for details on waste disposal facilities.

16.5.4 Cleaner production

Cleaner production is a continual improvement process designed to maximise resource usage and operational efficiency to minimise waste disposal.

Cleaner production techniques applicable to the Project are:

- Improved operation and maintenance practices to reduce the quantity of resources used and to minimise the amount of waste generated
- Selection and use of the most appropriate technology to reduce the quantity of resources used and to minimise the amount of waste generated
- Segregation of waste to facilitate re-use
- Closed-loop recycling.

16.5.5 Waste disposal facilities

Australia Pacific LNG does not propose to construct any new landfills as part of the Project.

There are several landfills within the development area that may be used for the disposal of general waste including Chinchilla, Dalby, Miles and Wandoan. Table 16.3 details the local landfills and the accepted waste types. Australia Pacific LNG will work with local councils to determine the current landfill capacities and accepted waste types, and will work with councils to assist with the planning of expansion and upgrade of landfills to ensure wastes generated from the Project can be accommodated if required.

Table 16.3 Local landfills and accepted wastes

Landfill	Location	Capacity	Accepted wastes
Chinchilla	Clarkes Road Chinchilla	Some capacity	General waste, construction and demolition waste, commercial and industrial waste, scrap steel, green waste, timber and recyclables
Dalby	Dalby-Jandowae Road Dalby	Limited capacity	General waste, construction and demolition waste, commercial and industrial waste, scrap steel, green waste, timber and recyclables
Miles	Leichardt Highway Miles	Limited capacity	General waste, construction and demolition waste, commercial and industrial waste, scrap steel, green waste, timber and recyclables
Wandoan	Tip Road Wandoan	Near capacity	General waste, construction and demolition waste, commercial and industrial waste, scrap steel, green waste, timber and recyclables

Source: Western Downs Regional Council (n.d.)

16.5.6 Waste treatment, handling and storage

Waste treatment

The treatment of sewage, stormwater and associated water will be the only waste treatment to occur onsite. Section 16.3.4 describes the sewage and stormwater treatment.

Associated water produced from the wells is transported to the WTFs via the low pressure water gathering network. The water is initially stored in lined feed ponds prior to treatment which will consist of:

- Pre-treatment technologies comprising disc filtration, membrane filtration and ion exchange
- Desalination comprising primary and secondary treatment.

The treatment creates two streams, permeate (freshwater), and brine (highly saline). Permeate will be used for beneficial re-use and the brine will be routed to the brine ponds for evaporation.

Refer to Volume 2 Chapter 12 for further details including volumes and chemical composition.

Waste handling and storage

Designated waste management areas will be constructed at the GPFs, WTFs and accommodation facilities for sorting the wastes into the various waste streams and waste storage prior to transport off-site. The waste management areas will be bunded or have a suitable containment system in place for the type of waste to be stored. The areas will have appropriate drainage and sump systems in place to assist with the drainage and removal of any waste materials or products released into the containment system. The containment systems will ensure wastes are contained and do not cause environmental harm including surface water and groundwater contamination.

General wastes will be separated and stored within designated labelled bins in the waste management area as follows:

- Aluminium cans, glass, recyclable plastics

- Paper and cardboard
- General waste including putrescibles
- Batteries

There will be a dedicated section in the waste management areas for hazardous wastes. They will be stored within sealed containers within a bunded area. The following measures will be implemented to prevent environmental harm:

- Bunds will be designed in accordance with Australian Standard AS 1940 – The storage and handling of flammable and combustible liquids.
- Bunds containing liquid will be pumped out as required and disposed of appropriately
- Where practicable, all loading and unloading will take place within the containment area
- Containers storing hazardous waste will be securely closed
- All containers will be labelled for clear interpretation of the contents
- Hazardous wastes will not be mixed with non hazardous wastes
- Spills containment material and spill kits will be provided.

Material safety data sheets provide information on specific materials and products including storage and handling requirements. The relevant data sheets for waste products will be kept onsite and made accessible to all personnel working with or working within the location of the designated waste storage area.

16.5.7 Spill containment and remediation

Australia Pacific LNG will implement standard procedures for the storage, handling, disposal and spill response for hazardous waste. Hazardous materials will be stored in appropriate bunding in accordance with Australian Standard AS 1940 and other relevant dangerous goods standards. Spill containment material and spill kits will be strategically located throughout the gas fields and training in spill response will be conducted for all employees.Where appropriate bioremediation measures will be implemented onsite to assist in remediation of any incident involving specific wastes.

16.5.8 Regulated waste tracking

A site register will be developed and maintained for all wastes generated onsite. It will include the following details:

- Source of waste
- Type of waste
- Quantity of waste
- Storage location
- Any storage particulars
- Dates of collection
- Date of disposal/recycling
- Name and details of transporter and facility used to dispose the waste.

The tracking of regulated wastes is a legal requirement under the *Environmental Protection (Waste Management) Regulation 2000*. Details including waste type, quantity, waste transporter and disposal location must be recorded and provided to Department of Environment and Resource Management. The treatment, storage and transport of regulated waste require an Environmental Authority under the *Environmental Protection Act 1994*. Where a contractor carries out these activities, the contractor will be required to hold the appropriate approvals.

16.5.9 Waste auditing and monitoring

Waste streams, quantities and management practices will be audited during the construction and operational phases of the Project as part of the waste management guidelines (refer to Table 16.4). The objectives of auditing the waste management activities onsite include:

- Assessment of the actual wastes compared to predicted waste streams and quantities
- Monitor potential impacts from wastes
- Review the waste transportation records
- Recommend future actions to improve waste management practices
- Monitor the implementation of the principles of waste management hierarchy.

Weekly inspections will be conducted on the designated site waste management areas to ensure that the waste material is appropriately separated, stored and labelled.

All unidentified wastes will be assessed to determine the appropriate management measures to use when handling, storing, transporting and disposing of the waste. This process may involve the investigation of a sample of the waste material which will be sent to an accredited laboratory for analysis and a risk assessment to assess the risks associated with handling and disposal of the waste.

16.5.10 Waste reporting

The National Environmental Protection Council has endorsed a National Environment Protection (Movement of Controlled Waste between States and Territories) Measure in the form of the National Pollutant Inventory. It is a database designed to provide stakeholders and government agencies information on the type and quantity of substances emitted to land, water and air. The objectives of the Inventory are to:

- Provide information to industry and government to assist with environmental planning and management
- Provide the community up to date information about substance emissions and transfers from industrial facilities
- Promote waste minimisation, cleaner production, and energy and resource efficiency.

Reporting on emissions will be an annual requirement for the project.

The objective of the National Environment Protection Measure is to 'provide a national framework for developing and integrating State and Territory systems for the management of the movement of controlled wastes between States and Territories originating from commercial, trade, industrial or business activities'. There will be no wastes transported to other States or Territories as part of the Project. Therefore this measure is not relevant.

Table 16.4 Waste inventory, quantity, impacts and management

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
Construction	Soils	Earthworks	Inert material	No excess soil	Erosion and sedimentation Surface water quality degradation due to runoff from stockpiles	Soils will be stripped and stockpiled in accordance with the EM Plan and re-used onsite during rehabilitation following construction Stockpiles will be located within cleared areas and away from drainage lines Key initiatives – waste re-use	Re-used onsite	Volume 2 Chapter 3 – Project description Volume 2 Chapter 5 – Geology, topography, geomorphology, soils and land contamination Volume 2 Chapter 24 – Environmental management plan
Construction	Green waste	Clearing of vegetation for construction of facilities	Organic material	No excess vegetation	Release of waste causing contamination of land and surface water Fire risk	Temporary stockpiles will be located within cleared areas away from drainage lines Vegetation material (including mulching) will be used during rehabilitation Trees with hollows will be left onsite for fauna habitat where practicable Weeds to be managed in a manner consistent with the appropriate weed classification and recognised Queensland weed management strategy Key initiatives – waste avoidance, waste re-use	Re-used onsite during rehabilitation Weeds to be managed in a manner consistent with the appropriate weed classification and recognised weed management strategy	Volume 2 Chapter 3 – Project description Volume 2 Chapter 8 – Terrestrial ecology Volume 2 Chapter 24 – Environmental management plan
Construction	Construction material (e.g. pipe off-cuts, concrete/rubble, timber, pallets)	Construction of all facilities within the gas fields	80% Recyclable	Zero to 1t/per well site during construction 90m^3/GPF general construction waste 96m^3/WTF 80m^3/temporary accommodation facility	Release of waste causing contamination of land and surface water Visual amenity impacts due to poor housekeeping	All construction waste will be segregated to maximise re-use and recycling opportunities All wastes will be stored within designated waste management areas Local business will be encouraged to take advantage of opportunities for re-use and recycling, if available or initiate opportunities, if unavailable Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste where practicable Key initiatives – waste avoidance, waste re-use, recycle and cleaner production	Recyclables - transported by a licensed contractor to a recycling facility Non recyclable – transported by a licensed contractor to a licensed landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Construction	Waste oils, oily rags,	Drilling activities, construction of	Regulated waste	<1m^{3}well 4m^3/GPF	Spills and overflows causing contamination of land, surface water	Bins and/or drums will be designated for the storage of used oils, oily rags and empty oil containers	Transported by a licensed contractor to a	Volume 2 Chapter 3 – Project description

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
	empty oil containers	gas plants, water treatment facilities and temporary accommodation facilities		$4m^3$/WTF $1.5m^3$/temporary accommodation facility $1m^3$/temporary accommodation facility cooking oil	and groundwater Release of containers to the environment causing contamination of land and surface water Releases causing degradation of biodiversity i.e. native flora and fauna. Visual amenity impacts due to poor housekeeping	Liquid wastes will be stored separately to solid wastes to maximise recycling opportunities Bins and/or drums will be sealed, labelled and stored within appropriately bunded areas in accordance with AS1940 and located within waste management areas Spill kits will be strategically located throughout the gas fields Contracts with companies will be established to encourage the opportunities for recycling waste oils Key initiatives – waste re-use, recycle and cleaner production	recycling facility where possible Remaining waste to be transported to a licensed regulated waste landfill	Volume 2 Chapter 24 – Environmental management plan
Construction	High density polyethylene lining	Construction of water treatment stations and brine ponds	Recyclable	$10m^3$/year/facility	Littering of land and surface water Visual amenity impacts due to poor housekeeping	Wastes will be transported to the nearest waste management area and segregated to maximise recycling opportunities Local business will be encouraged to take advantage of opportunities for re-use and recycling, if available or initiate opportunities, if unavailable Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste where practicable Key initiatives – waste avoidance, waste re-use, recycle and cleaner production	Transported by a licensed contractor to a recycling facility	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Construction	Used chemicals, empty chemical/ paint/solvent containers	Drilling activities, construction of gas plants, water treatment facilities and temporary accommodation facilities	Regulated waste	$2m^3$/GPF $24m^3$/WTF 0.5 m^3/temporary accommodation facility $<1m^3$/well	Spills and overflows causing contamination of land, surface water and groundwater Release of containers to the environment causing contamination of land and surface water Release causing degradation of biodiversity i.e. native flora and fauna Visual amenity impacts due to poor housekeeping	Bins and/or drums will be designated for the storage of used chemicals, empty chemical/paint/solvent containers Liquid wastes will be stored separately to solid wastes to maximise recycling opportunities Bins and/or drums will be sealed, labelled and stored within appropriately bunded areas and where required in accordance with AS1940 and located within waste management areas Spill kits will be strategically located throughout the gas fields Contracts with companies will be established to encourage the opportunities for recycling waste chemicals Key initiatives – waste re-use, recycle and cleaner production	Transported by a licensed contractor to a recycling facility where possible Remaining waste to be transported to a licensed regulated waste landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
Construction	Hydrotest water	Testing of high pressure pipelines and water transfer pipelines	Water with potential contaminates of silts, cleaning chemicals, traces of biocides and oxygen scavengers	100ML gas field	Release of hydrotest water causing surface water and groundwater contamination Release of hydrotest water causing erosion and degradation of biodiversity i.e. native flora and fauna	Contamination will be minimised through: • designing with an appropriate safety factor on storage capacity of all hydrotest dams • selecting biocide and oxygen scavenger (if necessary) which can be neutralised, are biodegradable, or do not bio-accumulate in the soil • monitoring of hydrotest water and receiving water quality • discharging hydrotest water in compliance with all regulatory and landholder requirements • selecting chemical additives that are least harmful to the environment Erosion caused by hydrotesting activities will be minimised through: • constructing erosion control measures at discharge locations • locating suction pumps to avoid significant vegetation and minimise disturbance to vegetation • locating suction pumps above the watercourse bed to minimise erosion	Discharge to land and watercourses	Volume 2 Chapter 11 – Surface water Volume 2 Chapter 24 – Environmental management plan
Construction	Drilling cuttings Drilling fluids	Drilling activities	Inert material	Cuttings - 45-55m^3/well Fluids - 200m^3/well	Release of waste causing contamination of land, surface, water and groundwater Release causing degradation of biodiversity i.e. native flora and fauna Visual amenity impacts due to poor housekeeping	Stored within sumps located on the drill pad. Once drilling is complete, the sumps left to settle out. The fluids (approximately 200m^3/well) is pumped out and transported to the feed ponds at the WTFs and the solids are mixed with subsoil, buried, covered and rehabilitated Investigate the re-use of drilling mud and cuttings	Onsite disposal	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Construction	Air emissions	Emissions generated are likely to consist of engine exhausts from vehicles and diesel generators, and dust from earthworks and vehicle movements on sealed and unsealed roads.	The composition of engine exhaust emissions is expected to be primarily NOX and carbon monoxide (CO) with small quantities of hydrocarbons.	As per emissions provided in Volume 2 Chapter 13	Release of air emissions results in: • decrease in human, terrestrial flora and fauna health • community dust nuisance • decrease in agricultural production.	Vehicles and machinery used in the construction of the gas fields will be fitted with appropriate emission control equipment and maintained in a proper and efficient manner in accordance with the manufacturer's specifications Dust mitigation measures will be implemented including • minimising disturbance footprint • minimising duration of disturbance • use of dust suppression methods including watering.	Air shed	Volume 2 Chapter 13 – Air quality Volume 2 Chapter 24 – Environmental management plan

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
Construction and operation	General waste including putrescibles	**Construction** Temporary accommodation facilities, drilling, gas plants, water treatment facilities **Operation** Permanent accommodation facilities packaging, food wastes etc	General waste	**Construction** 45m^3/GPF 7m^3/WTF 40m^3/temporary accommodation facility 0.1m^3/well **Operation** 120m^3/year/GPF/ 2700m^3/permanent accommodation facility[1]/year	Release of waste causing contamination of land and surface water Release causing degradation of biodiversity i.e. native flora and fauna Visual amenity impacts due to poor housekeeping Increase in vermin	There will be designated waste management areas for general waste storage. These will be closed to prevent land and water contamination and access for vermin A licensed waste management contractor will be contracted to supply bins, transport waste and dispose of non-recyclable waste at licensed landfills Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste where practicable Key initiatives – waste avoidance, waste re-use, recycle and cleaner production	Transported by a licensed contractor to a suitable licensed landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Construction and operation	Paper and cardboard	General packaging, accommodation facilities and office waste, cardboard boxes, newspapers.	Recyclable	**Construction** 45m^3/ GPF 7m^3/ WTF 40m^3/ temporary accommodation facility **Operation** 50m^3/GPF/year 3400m^3/permanent accommodation facility[1]/year	Littering of land and surface water Visual amenity impacts due to poor housekeeping Fire hazard	Paper and cardboard waste will be segregated and stored within the designated waste management area Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Contracts with companies will be established to encourage the opportunities for paper and cardboard recycling Key initiatives – waste avoidance, waste re-use, recycle and cleaner production	Transported by a licensed contractor to a recycling facility	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Construction and operation	Sewage and greywater	Greywater and sewage from bathrooms, toilets, showers, sinks and kitchens	Regulated waste	150L/person/day	Spills and overflows causing contamination of land, surface water and groundwater Release of waste causing degradation of biodiversity i.e. native flora and fauna Visual amenity impacts due to poor housekeeping Increase in vermin	Package sewage treatment facilities will be located at each of the accommodation facilities, WTFs and GPFs. The treatment facilities will be designed treat the waste to Class C recycled wastewater quality. Absorption beds and/or irrigation fields will be used for treated wastewater disposal and will be located and designed to avoid: • sensitive areas • soil erosion • surface ponding • impacts to ground water quality Signs will be erected around absorption beds and/or	Irrigation beds/absorption beds Sludge will be transported by a licensed contractor to a suitable licensed regulated landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan

[1] Assumes a 300 person permanent accommodation facility

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
						irrigation fields to restrict access The treatment facilities will be designed to include alternative storage and disposal options during times of system failure and in conditions that prevent discharge to land (i.e. during rain events) Sewage from small accommodation facilities such as drilling rigs and advance accommodation facilities will be disposed of onsite in an appropriate manner		
Construction and operation	Contaminated stormwater	GPFs, WTFs and accommodation facilities	Potentially contaminated with sediments, hydrocarbons and chemicals	Unknown	Release of stormwater causing surface water and groundwater contamination Release of stormwater causing degradation of biodiversity i.e. native flora and fauna	Stormwater capture and treatment, removal of sediments from sedimentation basins will be in accordance with guidelines/standards, e.g. Institute of Engineers Australia – Erosions and Sediment Control Guidelines (1996) Stormwater management will include the use of swales and basins Bins, drums and/or tanks for chemical storage will be sealed, labelled and stored within appropriately bunded areas and where required in accordance with AS1940 and located within waste management areas	Discharged to land and watercourses	Volume 2 Chapter 11 – Surface water Volume 2 Chapter 24 – Environmental management plan
Operation	Air emissions	Emissions from the operation of major facilities	Oxides of nitrogen (NO_X), as nitrogen dioxide (NO_2) Sulphur dioxide (SO_2) Carbon monoxide (CO) Particulate matter with an aerodynamic diameter less than ten microns (PM_{10}) Hydrocarbons	As per emissions provided in Volume 2 Chapter 13 (Air)	Release of air emissions results in: • decrease in human, terrestrial flora and fauna health • community dust nuisance • decrease in agricultural production.	Alternative low emission technologies will be investigated as appropriate including electric drive motors Venting of gas at wellheads will be restricted to emergency situations and periodic maintenance activities Lean-burn gas-fired engines with lower NO_X emissions will be used wherever practicable Flaring at GPFs will be minimised by implementing suitable control strategies	Air shed	Volume 2 Chapter 13 – Air quality
Operation	Scrap metal	GPFs, WTFs and gas and water gathering network	Recyclable	2.8t/gathering network/year 2t/year/GPF 2t/year/WTF	Littering of land and surface water Visual amenity impacts due to poor housekeeping	Scrap metal will be segregated and stored within designated areas in the waste management areas Local business will be encouraged to take advantage of opportunities for re-use and recycling, if available or initiate opportunities, if unavailable	Transported by a licensed contractor to a recycling facility	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
						Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste where practicable Key initiatives – waste avoidance, waste re-use, recycle and cleaner production		
Operation	Poly pipe	GPFs and WTFs	Recyclable	20t/year	Littering of land and surface water Visual amenity impacts due to poor housekeeping	All poly pipe waste will be segregated and stored within the waste management areas Local business will be encouraged to take advantage of opportunities for re-use and recycling, if available or initiate opportunities, if unavailable Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste where practicable Key initiatives – waste avoidance, waste re-use, recycle and cleaner production	Transported by a licensed contractor to a recycling facility	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Operation	Tyres	GPFs and accommodation facilities	Recyclable	40m^3/year across the gas fields	Littering of land and surface water Visual amenity impacts due to poor housekeeping	All tyres will be segregation and stored within the waste management areas prior to transport off-site for recycling Key initiatives –waste recycle	Transported by a licensed contractor to a recycling facility	
Operation	Empty Drums	GPFs and WTFs	Regulated waste	115 drums/year/facility	Release of waste causing contamination of land and surface water Visual amenity impacts due to poor housekeeping	Drums will be labelled and stored within appropriately bunded areas in accordance with AS1940 and located in the waste management areas Contracts with companies will be established to encourage the opportunities for recycling drums Key initiatives – recycle and cleaner production	Transported by a licensed contractor to a recycling facility where possible Remaining waste to be transported to a licensed regulated waste landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Operation	Wet oil, dry oil, coolant, sump fluid, sullage	GPFs and WTFs	Regulated waste	Wet Oil – 156m^3/year/facility Dry oil – 52m^3/year/facility Coolant – 416m^3/year/facility Sump fluid - 1404m^3/year/facility Sullage –	Spills and overflows causing contamination of land, surface water and groundwater Releases causing degradation of biodiversity i.e. native flora and fauna Visual amenity impacts due to poor housekeeping	Bins and/or drums will be designated for the storage of wastes Wastes will be stored separately to maximise recycling opportunities Bins and/or drums will be sealed, labelled and stored within appropriately bunded areas in accordance with AS1940 and located within the waste management areas Spill kits will be strategically located throughout the gas fields	Transported by a licensed contractor to a recycling facility where possible Remaining waste to be transported to a suitable licensed landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
				15m^3/year/facility		Contracts with companies will be established to encourage the opportunities for recycling the liquid waste Key initiatives – waste re-use, recycle and cleaner production		
Operation	Filters	GPFs and WTFs	Regulated waste	25 drums/year/facility	Release of waste causing contamination of land and surface water Visual amenity impacts due to poor housekeeping	Bins and/or drums will be designated for the storage of used filters Bins and/or drums will be sealed, labelled and stored within appropriately bunded areas in accordance with AS1940 and located within the waste management areas Spill kits will be strategically located throughout the gas fields Contracts with companies will be established to encourage the opportunities for recycling used filters Key initiatives – waste re-use, recycle and cleaner production	Transported by a licensed contractor to a recycling facility where possible Remaining waste to be transported to a licensed regulated waste landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Operation	Oily Rags	GPFs and WTFs	Regulated waste	30 drums/year/facility	Release of waste causing contamination of land and surface water Visual amenity impacts due to poor housekeeping	Bins and/or drums will be designated for the storage of oily rags Drums will be sealed, labelled and stored within appropriately bunded areas in accordance with AS1940 and located within the waste management areas Contracts with companies will be established to encourage the opportunities for recycling oily rags Key initiatives – waste re-use, recycle and cleaner production	Transported by a licensed contractor to a recycling facility where possible Remaining waste to be transported to licensed regulated waste landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Operation	Contaminated Soil	GPFs and WTFs	Regulated waste	30m^3/year/facility	Release of waste causing contamination of land and surface water Releases causing degradation of biodiversity i.e. native flora and fauna Visual amenity impacts due to poor housekeeping	A bunded area will be designated for the storage of contaminated soil Contracts with companies will be established to encourage the opportunities for remediating contaminated soil Where appropriate bioremediation measures will be implemented onsite to assist in remediation of any incident involving specific wastes Key initiatives – waste re-use and cleaner production	Transported by a licensed contractor to a suitable facility for remediation	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Operation	Batteries	GPFs and WTFs	Regulated waste	100 batteries/year	Release of waste causing contamination of land and surface water Visual amenity impacts due to poor housekeeping	Bins, drums and/or pallets will be designated for the storage of batteries Bins, drums and/or pallets will be labelled and stored within appropriately bunded areas and located within the waste management areas	Transported by a licensed contractor to a recycling facility where possible Remaining waste to be	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
						Contracts with companies will be established to encourage the opportunities for recycling batteries Key initiatives – waste re-use, recycle and cleaner production	transported to a licensed regulated waste landfill	
Operation	General maintenance waste (waste rags, packaging etc)	GPFs	General waste	40m^3/year/facility	Release of waste causing contamination of land and surface water Visual amenity impacts due to poor housekeeping	There will be waste management at each GPF, WTF and accommodation facility for general maintenance waste storage. Skips will be closed to prevent land and water contamination A licensed waste management contractor will be contracted to supply bins, transport waste and dispose of non-recyclable waste at local landfills Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste where practicable Key initiatives – waste avoidance, waste re-use, recycle and cleaner production	Transported by a licensed contractor to a recycling facility where possible Remaining waste to be transported to a licensed landfill	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Operation	Timber	Timber from packaging and very limited landscape maintenance.	Organic material	10 tonnes/year/facility	Littering of land and surface water Fire hazard Visual amenity impacts due to poor housekeeping	All timber waste will be segregated and stored within the waste management area Timber will be re-used onsite and/or mulched onsite for rehabilitation purposes, where possible Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices Contracts with companies will be established to encourage the opportunities for timber recycling Key initiatives –waste re-use and recycle	Re-used onsite or transported by a licensed contractor to a recycling facility	Volume 2 Chapter 3 – Project description Volume 2 Chapter 24 – Environmental management plan
Operation	Associated water	WTFs	Total dissolved solids – 2,450mg/L to 7,500mg/L pH values – 8.3 to 9 Total suspended solids – 9 mg/L to 80mg/L	Estimated to peak at 170ML/d	Release of permeate to creeks/rivers causing alterations to flow regimes, changes to water quality and bed scour and associated bank erosion.	Associated water discharges to watercourses will be in a manner that meets environmental flow objectives and mimics pre development stream flows where practicable Discharge infrastructure will be designed to minimise localised velocity and scour and achieve appropriate mixing Ongoing monitoring of downstream reaches Continued investigation and implementation of alternative beneficial use and disposal options	Discharge into creeks and streams. Potential beneficial re-use options include industrial use, potable water supply, agricultural use or injection into aquifers	Volume 2 Chapter 12 – Associated water management

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Destination	Section of the EIS
			Sodium adsorption ratio – 115 to 170 Residual Alkalinity – 13.6meq/L to 43meq/L Fluoride by ISE – 0.9mg/L to 5.9mg/L Boron – 0.4mg/L to 3.1mg/L					
Operation	Brine	WTFs	Liquid waste with a high saline concentration	Approximately 5% of associated water flow will be transported to the brine ponds following treatment in the WTF.	Brine pond overflows causing surface water and groundwater contamination Brine pond seepage causing surface water and groundwater contamination Release/seepage of brine causing degradation of biodiversity i.e. native flora and fauna	The brine ponds are classified as a significant hazard according to Department of Environment and Resource Management guidelines. As a result, the ponds will be appropriately designed, managed and controlled to meet regulatory requirements for the hazard category Continuous maintenance and monitoring of embankment structures will be conducted	Brine ponds for evaporation. Potential beneficial re-use of brine including; producing potentially saleable salt products, implementing salt crystallisation and burying salts in approved waste management facilities or injecting high concentration brines into deep, hydraulically isolated geological reservoirs.	Volume 2 Chapter 12 – Associated water management
Decommissioning	Plant equipment Buildings Scrap steel Electrical waste Pipelines Concrete	Decommissioning of all above ground facilities	Recyclable Regulated waste General waste	Reuse and disposal equipment, as required	Release of waste causing contamination of land, surface water and groundwater Fire hazard Visual amenity impacts due to poor housekeeping	Further assessment of the decommissioning and rehabilitation wastes will be undertaken in accordance with Origin's standards and procedures and statutory requirements.	Transported by a licensed contractor to a recycling facility Transported to a licensed landfill	

16.6 Conclusions

16.6.1 Assessment outcomes

A summary of the sustainability principles, potential impacts and mitigation measures in relation to waste management is presented in Table 16.5.

This table also includes the residual risk levels for waste management. A risk assessment has been undertaken to identify the potential risks, causes and consequences from the generation and management of waste. Mitigation measures to reduce the risk have been nominated and the residual risk has been calculated. Further details on the risk assessment methodology are provided in Volume 1 Chapter 4.

Table 16.5 Summary of sustainability principles, potential impacts and mitigation measures

Environmental values	Sustainability principles	Potential impacts	Possible causes	Mitigation and management measures	Residual risk level
Life, health and well-being of people Diversity of ecological processes and associated ecosystems Land use capability, having regard to economic considerations	Minimising adverse environmental impacts and enhancing environmental benefits associated with Australia Pacific LNG's activities, products or services; conserving, protecting, and enhancing where the opportunity exists, the biodiversity values and water resources in its operational areas Identifying, assessing, managing, monitoring and reviewing risks to its workforce, Australia Pacific LNG's property, the environment and the communities affected by its activities	Release of waste causing contamination of land, surface water and groundwater Release of waste causing degradation of biodiversity i.e. Native flora and fauna Visual amenity impacts due to poor housekeeping Ignition sources for fires Increase in vermin populations	Inappropriate waste handling and/or storage Poor housekeeping	Wastes will be appropriately segregated and stored within designated waste management areas Waste will be transported by a licensed contractor to a recycling facility or suitable licensed landfill Bins and/or drums for regulated wastes will be sealed, labelled and stored within appropriately bunded areas in accordance with AS1940 and located within waste management areas Liquid wastes will be stored separately to solid wastes to maximise recycling opportunities Spill kits will be strategically located throughout the gas fields Package sewage treatment facilities will be appropriately designed and include alternative storage and disposal options during times of system failure and in conditions that prevent discharge to land (i.e. during rain events) Hydrotest water will be appropriately managed to minimise land and water contamination and erosion Weeds to be managed in a manner consistent with the appropriate weed classification and recognised Queensland weed management strategy Vegetation material (including mulching) will be used onsite during rehabilitation Stockpiles will be located within cleared areas and away from drainage lines	Low

Environmental values	Sustainability principles	Potential impacts	Possible causes	Mitigation and management measures	Residual risk level
				Stormwater capture and treatment, removal of sediments from sedimentation basins will be in accordance with guidelines/standards, e.g. Institute of Engineers Australia – Erosions and Sediment Control Guidelines (1996). Associated water discharges to watercourses will be in a manner that meets environmental flow objectives and mimics pre development stream flows where practicable. Discharge infrastructure will be designed to minimise localised velocity and scour and achieve appropriate mixing. Brine ponds will be appropriately designed, managed and controlled to meet regulatory requirements for the hazardous dams. Vehicles and machinery will be fitted with appropriate emission control equipment and maintained in a proper and efficient manner in accordance with the manufacturer's specifications. Dust mitigation measures will be implemented. Alternative low emission technologies will be investigated as appropriate including electric drive motors. Venting of gas at wellheads will be restricted to emergency situations and periodic maintenance activities. Lean-burn gas-fired engines with lower NO_X emissions will be used wherever practicable. Flaring at GPFs will be minimised by implementing suitable control strategies.	

Environmental values	Sustainability principles	Potential impacts	Possible causes	Mitigation and management measures	Residual risk level
Management of finite resources	Using resources efficiently, reducing the intensity of materials used and implementing programs for the reduction and re-use of waste Working cooperatively with communities, governments and other stakeholders to achieve positive social and environmental outcomes, seeking partnership approaches where appropriate.	Inefficient use of resources Generation of excessive quantities of waste Insufficient landfill airspace	Unsuccessful implementation of the waste management hierarchy and cleaner production techniques.	Local business will be encouraged to take advantage of opportunities for re-use and recycling, if available or initiate opportunities, if unavailable. Contracts with companies (for the supply of materials) will be established encouraging sustainable waste management practices. Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste where practicable. Segregation of wastes to maximise re-use and recycling opportunities. Australia Pacific LNG will work with local councils to determine the current landfill capacities and accepted waste type and will work with council to assist with the planning of expansion and upgrade of landfills to ensure wastes generated from the Project can be accommodated if required. Waste to be transported by a licensed contractor to a recycling facility or suitable licensed landfill. Liquid wastes will be stored separately to solid wastes to maximise recycling opportunities.	Low

16.6.2 Commitments

Australia Pacific LNG will:

- Develop and implement a detailed waste management guideline across the gas fields utilising the principles of the waste management hierarchy
- Work with local councils to determine the current landfill capacities and accepted waste types and will work with councils to assist with the planning of expansion and upgrade of landfills to ensure wastes generated from the Project can be accommodated if required
- Establish contracts with companies encouraging sustainable waste management practices
- Encourage the procurement of pre-fabricated materials where practicable
- Encourage local businesses to take advantage of opportunities for re-use and recycling, if available or initiate opportunities, if unavailable
- Regularly review of the waste management plan including the marketability of wastes and the results of waste audits to improve waste management within the gas fields.

References

Western Downs Regional Council n.d., Waste Management Facilities, viewed 12 October 2009, <www.wdrc.qld.gov.au>.