Draft environmental management plan

Waste management plan

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Santos
GLNG Project

Santos GLNG Upstream

Waste Management Plan

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Abbreviations and Units

Acronym	Description
AS	Australian Standard
AWAF	Associated Water Amendment Facilities
CSG	Coal Seam Gas
CS Water	Coal Seam Water
DFRC	Drilling Fluid Recycling Centre
EA	Environmental Authority
EHP	Department of Environment and Heritage Protection
EHS	Environment, Health and Safety
EHSMS	Environment, Health and Safety Management System
EIS	Environmental Impact Statement
EP Act	*Environmental Protection Act 1994*
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
EP Regulation	*Environmental Protection Regulation 2008*
EP Waste Regulation	*Environmental Protection (Waste Management) Regulation 2000*
GED	General Environmental Duty
GLNG	Gladstone Liquefied Natural Gas
HDPE	High Density Polyethylene
IBC	Intermediate Bulk Container
MNES	Matters of National Environmental Significance
MSDS	Material Safety Data Sheet
NEPM	National Environment Protection
NPI	National Pollutant Inventory
NZS	Standards New Zealand
ROC	Reverse Osmosis Concentrate
ROP	Reverse Osmosis Plant
SDPWO Act	*State Development and Public Works Organisation Act 1971*
STP	Sewage Treatment Plant
TEG	Triethylene Glycol
WRR Act	*Waste Reduction and Recycling Act 2011*
WMP	Waste Management Plan
WTC	Waste Tracking Certificate

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1.0 Introduction

The construction, operation and eventual decommissioning phases of the Santos GLNG Project will result in the generation of a series of waste streams and products. The improper management and disposal of waste by Santos GLNG has potential to cause adverse impacts to both environmental and social values, including in some instances, impacts to human health.

To ensure the appropriate management and disposal of project related waste, Santos GLNG has developed a framework for addressing waste management. This Waste Management Plan (WMP) provides an overview of the framework and management practices utilised by Santos GLNG to manage the waste streams generated in the Santos GLNG Upstream Project Area.

1.1 Purpose and Scope of the WMP

1.1.1 Purpose

Santos GLNG has both a legal and social responsibility to minimise and appropriately manage wastes generated by Santos GLNG activities and assets. This WMP has been prepared to satisfy these obligations and complements the overarching Santos Environment, Health and Safety Management System (EHSMS).

The objectives of the WMP are to:

- Facilitate compliance with relevant Commonwealth, State and Local Government legislation, regulations and approvals;
- Support the Santos *Environmental Hazard Standard 04 – Waste* (EHS04);
- Provide a framework for Santos GLNG to:
    - Identify, characterise and properly manage wastes at Santos GLNG assets and facilities;
    - Implement the waste management hierarchy of avoid, reduce, reuse, recycle, treat, dispose to minimise waste generation and disposal and promote the re-use, recycling and recovery of wastes;
    - Minimise the risk of causing harm to the environment that may arise due to improper waste management;
    - Engage stakeholders including local governments to assist in utilising appropriate waste management and disposal services and locations; and
    - Develop site-specific / activity-specific waste management procedures as required during the Project lifetime.

1.1.2 Scope

This WMP provides an overview of the strategy, methods and controls implemented by Santos GLNG to manage the issue of waste. Specifically, this WMP:

- Identifies the types of wastes generated by Santos GLNG; and
- Describes the waste management framework; and
- Describes how the waste management hierarchy is applied to Project generated wastes.

This WMP is to be implemented by all Santos GLNG Project personnel responsible for carrying out works that generate, transport, store, treat and/or dispose wastes throughout the exploration, construction, production, decommissioning and rehabilitation phases of the Project.

This WMP applies to activities carried out within the Santos GLNG Upstream Project Area. The Santos GLNG Upstream Project Area consists of Santos GLNG petroleum tenements comprising the Arcadia, Fairview, Roma and Scotia gas fields and as illustrated in Figure 1.

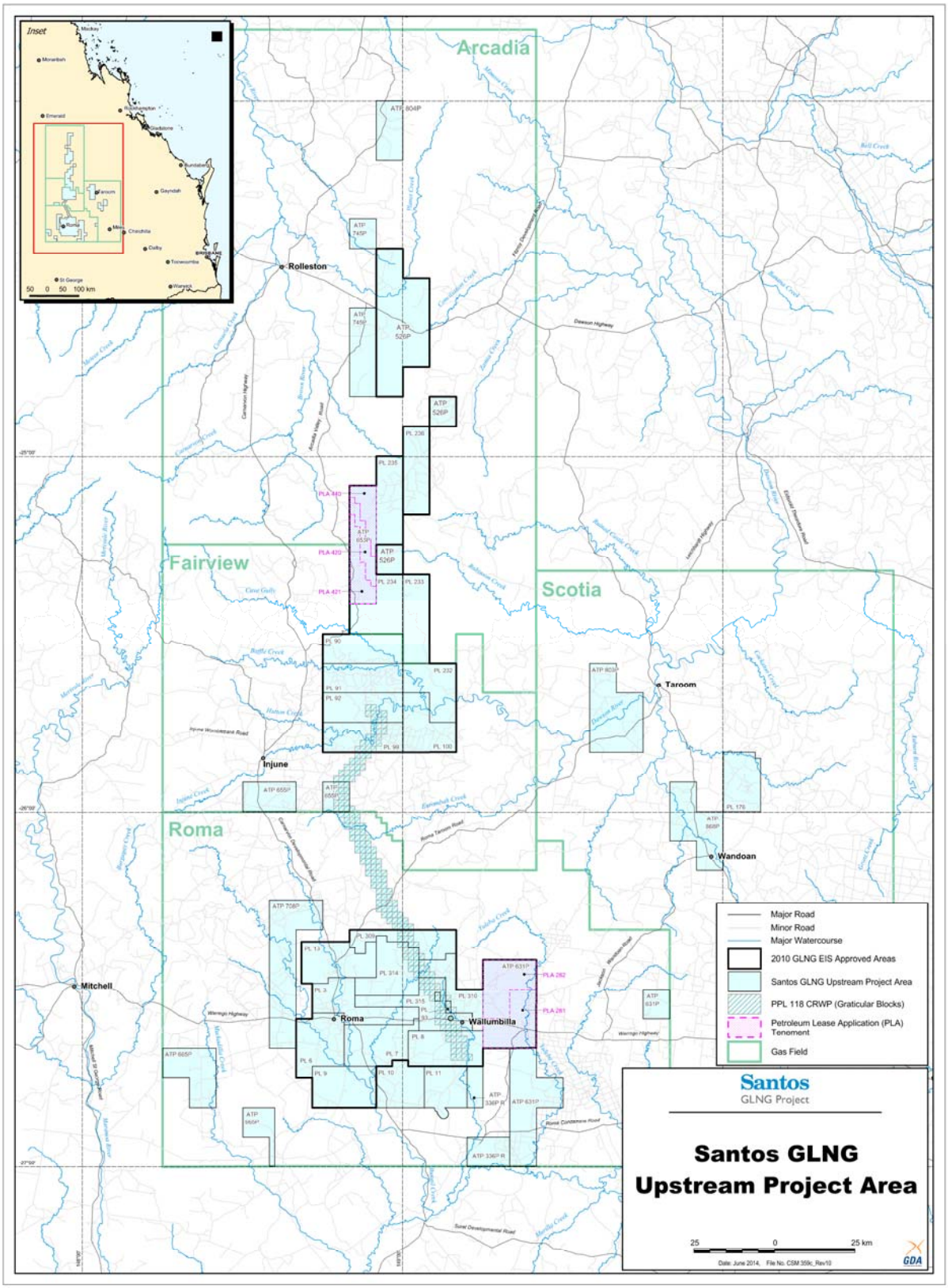

Figure 1: The Santos GLNG Upstream Project Area

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2.0 Roles and Responsibilities

Santos GLNG Project personnel are responsible for the environmental performance of their activities, for complying with relevant approval / permit requirements and for ensuring that all environmental objectives associated with the work are achieved. Santos GLNG Project personnel must also be mindful of the General Environmental Duty (GED) as outlined in the *Environmental Protection Act 1994* (Qld) (EP Act). Section 319(1) of the EP Act states that "*a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practical measures to prevent or minimise the harm.*"

Roles, responsibilities and accountability under the WMP will be assigned in accordance with the *Santos EHSMS05 – Responsibility and Accountability*.

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3.0 Legal and Other Requirements

Applicable legislation, regulations, guidance and strategies enacted by the Australian, Queensland and local governments regarding waste management in the Santos GLNG Upstream Project Area are described in the following sections.

3.1 Australian Government Legislation and Strategies

An overview of Australian Government legislation and strategies considered in the development of the WMP are presented in Table 1.

Table 1: Summary of Applicable Commonwealth Legislation and Strategies

Act or Strategy	Summary of Act or Strategy
Environmental Protection and Biodiversity Conservation Act 1999 **(EPBC Act)**	The EPBC Act regulates the protection of Matters of National Environmental Significance (MNES) to nationally provide for the conservation of the environment and biodiversity and natural and cultural places. Santos GLNG holds an EPBC Act approval that regulates adverse impacts on MNES from Santos GLNG activities, including from the management of coal seam water (CS water) and/or any by-products from its treatment.
National Waste Policy: Less Waste, More Resources	The National Waste Policy builds on the National Strategy for Ecologically Sustainable Development commitments to improve resource efficiency and reduce the environmental impacts of waste disposal. The National Waste Policy supports annual reporting of project waste emissions to land, air and water though the National Pollutant Inventory (NPI).
National Environment Protection (Movement of Controlled Waste between States and Territories) Measure (NEPM)	The NEPM provides a national framework for the management of the movement of controlled wastes between States and Territories. The NEPM provides for tracking interstate transport of controlled wastes and provides lists of waste streams, specific constituents and hazardous characteristics to identify whether materials are hazardous.
Australian Code for the Transport of Dangerous Goods by road and Rail	The Australian Code for the Transport of Dangerous Goods by road and Rail sets out technical requirements and guidelines for the transport of dangerous goods by road and rail and is implemented for roads in Queensland by the *Transport Operations (Road Use Management – Dangerous Goods) Regulation 1998.* Where wastes that constitute dangerous goods (e.g. flammable liquids/solids, corrosives etc) are to be transported from site, the transporter must comply with all the requirements of the Code and Regulation.

3.2 State Legislation and Strategies

An overview of Queensland legislation and strategies considered in the development of the WMP is presented in Table 2. The EP Act, the *Environmental Protection (Waste Management) Regulation 2000* (EP Waste Regulation) and the *Waste Reduction and Recycling Act 2011* (WRR Act) are the principal pieces of State legislation governing Santos GLNG's waste management practices.

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Table 2: Summary of Key Applicable State Legislation

Act / Regulation / Policy	Summary of Act
State Development and Public Works Organisation Act 1971 **(SDPWO Act)**	The SDWPO Act draws together a range of powers and functions used by the State Government to facilitate the approval of large projects. It provides a formal environmental impact state (EIS) process for declared 'significant' projects. The Queensland Coordinator General's evaluation report for the Santos GLNG Project, imposes a requirement for Santos GLNG to determine and implement appropriate methods for waste management and disposal, including specific requirements for CS water and brine management.
Environmental Protection Act 1994 **(EP Act)**	The EP Act provides for environmental management practices and environmental safeguards. The EP Act aims to reduce waste and ensure all waste is managed so not to cause health or environmental problems. The EP Act requires waste management, including waste prevention and minimisation. Santos GLNG holds a series of Environmental Authorities (EAs) issued under the EP Act authorising the development of the Santos GLNG Upstream Project Area. These EAs include provisions concerning the management of wastes. The EP Act also requires Santos GLNG to take all reasonable and practicable measures to prevent or minimise environmental harm as part of meeting the GED.
Environmental Protection Regulation 2008 (EP Regulation)	The EP Regulation establishes the Environmental Objectives and Performance Outcomes relevant to defined activities and receiving environment values. The treatment, transfer, storage and disposal of waste as a part of petroleum activities is authorised by this regulation.
Environmental Protection (Waste Management) Regulation 2000 (EP Waste Regulation)	The EP Waste Regulation aims to protect the environment by minimising the impact of waste on the environment and establishes an integrated framework for minimising and managing waste under the principles of ecological sustainable development. The Waste Regulation provides for the following key provisions, relevant to Santos GLNG activities: • Offences for the unlawful disposal of waste; • Definition of regulated and trackable wastes; and • A system for tracking the movement of trackable wastes (including regulated wastes) to ensure correct disposal.
Waste Reduction and Recycling Act 2011 **(WRR Act)**	The WRR Act establishes a framework to modernise waste management and resource recovery practices in Queensland. The key provisions of the WRR Act related to Santos GLNG activities include: • A requirement for Queensland Government agencies and local governments to prepare waste management plans; and • Introduction of product stewardship arrangements for any waste products that are identified as a growing problem for landfill in the future.
Waste Reduction and Recycling Regulation 2011 **(WRR Regulation)**	The *WRR Regulation* provides much of the detail of the WRR Act framework. The Regulation provides the following information: • A nil waste levy rate for all levy able waste delivered to a levy able waste disposal site; • Weight measurement criteria for levy able waste disposal sites without weigh bridges; • Fees associated with management of wastes;

Act / Regulation / Policy	Summary of Act
	• Prescribed activities and requirements for resource recovery areas; and • Planning for waste reduction and recycling and reporting about waste management.
Coal Seam Gas Water Management Policy 2012 (CS Water Policy)	The CS Water Policy is designed to encourage the beneficial use of CS water in a way that protects the environment and maximises its productive use as a valuable resource. The CS water is to be preferentially used for a purpose that is beneficial to the environment, water users and/or water dependent industries. Where this is not possible, CS water is to be treated and/or disposed of in a way that avoids, minimises or mitigates impacts on the environment.

3.3 Local Government Plans

The Santos GLNG Upstream Project Area lies within the jurisdiction of four local governments:

- Maranoa Regional Council;
- Central Highlands Regional Council;
- Banana Shire Council; and
- Western Downs Regional Council.

Local governments are required to comprehensively address all aspects of waste management in their respective local government area through waste reduction and recycling plans. Santos GLNG intends to liaise with local governments and will update the WMP as required to incorporate relevant information from local government waste reduction and recycling plans as they become available.

3.4 Santos Environment, Health and Safety Management System

The Santos EHSMS provides a framework for environmental and safety practices across Santos operations worldwide. The framework is consistent with *AS 4801:2000 Occupational Health and Safety Management Systems* and *AS/NZS ISO 14001:2004 Environmental Management Systems.*

This WMP complements the requirements of the EHSMS, in particular, the Santos Environmental Hazard Standard *EHS04 Waste Management.* This standard defines minimum acceptable standards for waste management activities for Santos activities. Additional relevant EHSMS standards include, *EHS02 – Underground Storage Tanks and Bunds, EHS06 – Environmental Impact Assessment and Approvals* and *HSHS08 – Chemical Management and Dangerous Goods*..

This WMP specifically addresses unique features and requirements relating to the Santos GLNG Project. Santos GLNG specific documentation is based on identified environmental and reputational risks and account for Santos GLNG's legal and other obligations, commitments made by the Santos GLNG Project and Santos GLNG's Social Licence to Operate. In this context, the WMP provides additional guidance for the management of environmental issues and supports the development of asset / activity / department based guidelines and work instructions, in order to secure compliance with legal requirements as well as deliver on company environmental standards.

The Santos approach to environmental management is illustrated in Figure 2.

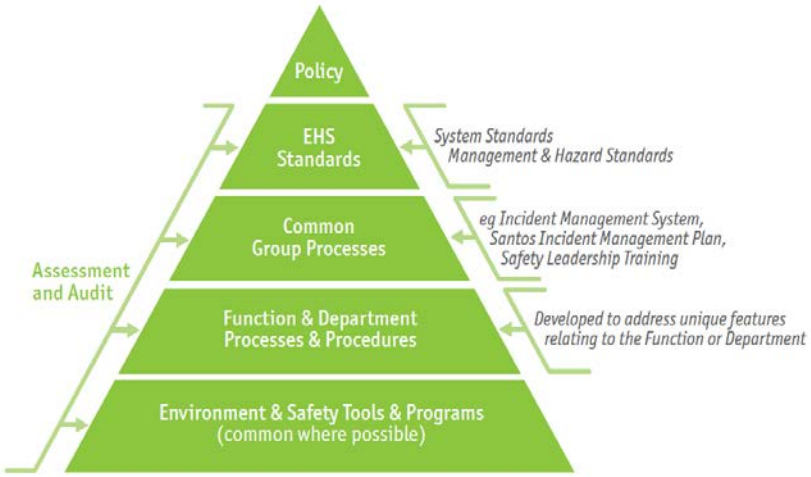

Figure 2: The Santos Approach to Environmental Management

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4.0 Waste in the Santos GLNG Upstream Project Area

4.1 Wastes Types Generated

Waste is defined by the EP Act as including anything that is left over, or an unwanted by-product or surplus, from an industrial, commercial, domestic or other activity. The Santos GLNG Upstream Project Area produces waste from a wide range of activities. The principal waste generating activities can be broadly classified as:

- Project construction activities;
- Coal Seam Gas (CSG) well drilling;
- CSG production / extraction;
- Gas processing;
- Water treatment;
- Activities incidental to construction and operation, such as camps and office facilities; and
- Asset decommissioning and abandonment activities.

Each of these activities generates a variety of waste products. Waste can be categorised as being one of the following three waste classes:

- **Regulated Waste** – wastes that require specific controls or actions as defined by legislation. Listed, hazardous, regulated, controlled or trackable wastes that typically have unique handling and disposal requirements in order to manage specific hazards associated with them.
- **General Disposable Waste** – is waste that is not classified as regulated waste or recyclable waste. General waste is comprised of two main waste streams: putrescible and non-putrescible.
- **General Recyclable Waste** – waste types that are able to be reconditioned, reprocessed or reused.

Further information for each of the waste classes is provided in the following sections.

4.1.1 Regulated Waste

Regulated wastes commonly generated by Santos GLNG are listed in Table 3. These wastes are generally subject to waste transport and reporting requirements and require careful on-site management.

Table 3: Regulated Wastes

Waste Name	Waste Description	Project Activity
Asbestos and Synthetic Mineral Fibre Insulation (SMF)	Asbestos can be found in materials such as lagging, insulation, gaskets and brake pads. Examples of SMF include waste insulation and rock wool.	All Activities.
Batteries	Lead acid batteries, gel type batteries, nickel cadmium batteries and alkaline batteries generated from equipment, vehicles, generators and electronics.	All Activities

Waste Name	Waste Description	Project Activity
Brine and Reverse Osmosis Concentrate (ROC)	Brine and ROC are generated from the treatment of CS water. ROC is where the electrical conductivity is between 15 000 and 40 000 µS/cm. Brine is where the electrical conductivity is ≥ 40 000 µS/cm.	Water Treatment Decommissioning and Abandonment
Chemical Waste and Chemical Containers	Chemical wastes may include herbicides, pesticides, water treatment chemicals, paints and solvents. Chemical containers are those containing any volume of free chemical that is a regulated waste and may include waste oil containers and aerosol cans containing solvent or paint.	All Activities
Contaminated Soil	Contaminated soils may be generated where localised spills of hydrocarbons and other contaminants occurs.	All Activities
Cooking Oil	Waste cooking oil is generated from kitchen facilities at camps.	Incidental Activities
CS Water	CS water is primarily generated from the operation of wells. CS water is a regulated waste when the water possesses an electrical conductivity equal to or greater than 15,000 µS/cm and a pH outside of the range of 6.0 - 10.5.	Production / Extraction Gas Processing Decommissioning and Abandonment
Drilling Fluid	Waste drilling fluids are generated from the drilling process.	Drilling
Drilling Muds and Cuttings	Waste drilling muds are generated from the drilling process.	Drilling
Grease Trap Waste	Grease trap waste is generated from kitchen facilities at camps.	Incidental Activities
Hydrostatic Test Water	Spend water used in the hydrotesting of pipelines, to test pipeline integrity. It is a regulated waste dependent on the constituents of any additives.	Construction
Medical and Clinical Waste	Sharps and biohazard wastes are generated at camps during routine medical care and treatment.	Incidental Activities
Oily Filters, Rags, Absorbents	Oily filters, rags and absorbents are generated from routine equipment and vehicle servicing, repair and filter changes.	All Activities
Oily Water and Oily Water Treatment Sludge	Oily water and sludge is primarily generated at gas treatment and processing at compressor stations. Oily water may also be produced from servicing equipment, machinery and vehicles.	Construction Production / Extraction Gas Processing Decommissioning and Abandonment
Septic	Septic waste is generated from on-site sewage treatment plants (STPs) and septic systems.	Incidental Activities
Stimulation Flowback Water	This waste is generated when the fluids used in the stimulation process are brought back to the surface.	Drilling

Waste Name	Waste Description	Project Activity
Triethylene Glycol (TEG) / Glycol / Coolant	Waste TEG / Glycol / Coolant is generated as part of the gas dehydration process and from equipment and vehicle fluid changes.	Construction Production / Extraction Gas Processing
Tyres	Tyres and tubes are generated from tyre changes on work vehicles and equipment.	Construction Production / Extraction Drilling Decommissioning and Abandonment
Used Spill Kits	Used spill kits are generated from spill clean-up of chemicals and hydrocarbons.	All Activities
Waste Oil (clean waste oil)	Small quantities of waste oil are generated routinely from vehicle and equipment oil changes.	All Activities

4.1.2 General Wastes

General wastes commonly generated within the Santos GLNG Upstream Project Area are listed in Table 4. These waste types are suitable for disposal to general landfill, with the exception of CS water and permeate.

Table 4: General Wastes

Waste Name	Waste Description	Project Activity
Concrete / Aggregate / Asphalt	Concrete, aggregate and asphalt materials removed from demolished Project infrastructure that are not suitable for recycling (see Table 5).	Decommissioning and Abandonment
CS Water*	CS water is primarily generated from the operation of wells. CS water is a general waste when the water possesses an electrical conductivity less than 15,000 µS/cm and a pH of between 6.0 - 10.5.	Production / Extraction Gas Processing Decommissioning and Abandonment
Green Waste	Whole or parts of trees, bushes, shrubs, grass or similar, produced from vegetation clearing activities.	Construction Operation / Extraction Drilling

Waste Name	Waste Description	Project Activity
Putrescible and other domestic wastes	• Food scraps, tea bags, coffee grounds etc. • Food wrappers and packaging materials • Textile materials • Plastic wrapping or film, plastic bags • Facial tissue, ear plugs • Pens and pencils • Polystyrene • Aluminium foil, waxy paper or cardboard • Non-recyclable plastics	All Activities
Pipeline Tape Wrap	Pipeline tape wrap protects the pipeline against corrosion.	Construction Production / Extraction
Permeate	Permeate is the treated CS water generated by water treatment plants.	Water Treatment Decommissioning and Abandonment
Rock Mesh	Rock mesh prevents rocks and debris from falling and when it needs to be replaced.	Construction Production / Extraction Decommissioning and Abandonment
Timber	Untreated timber derived from packaging and uses that cannot be reused or recycled.	All Activities Decommissioning and Abandonment
Treatment Filters and Membranes	Cartridge filters generated from the water treatment process.	Water Treatment Decommissioning and Abandonment
Wellhead Separator Waste (Coal Fines)	Separators at wellheads separate gas and water and remove other materials.	Production / Extraction

* CS water is classified as a general waste when it does not exceed concentration limits to be a regulated waste. However, CS water requires specialised management, due to its potential to cause harm.

4.1.3 Recyclable Waste

Recyclable wastes commonly generated within the Santos GLNG Upstream Project Area are presented in Table 5.

Table 5: Recyclable Wastes

Waste Name	Waste Description	Project Activity
Concrete / Aggregate / Asphalt	Suitable concrete, aggregate and asphalt materials removed from demolished Project infrastructure.	Decommissioning and Abandonment
General Recycling	• Plastic bottles and food containers • Glass bottles and jars, milk cartons, aluminium bottles	All Activities

Waste Name	Waste Description	Project Activity
	and cans, metal lids from jars, tin cans, aluminium cans, plastic cups • Cardboard and paper packaging • Folders, phone books, envelopes, office paper, magazines, cereal boxes, clean paper towels • Steel scraps	
Intermediate Bulk Containers (IBC)	Containers used for transport of fluids and bulk materials.	All Activities
Plastic (High Density Polyethylene (HDPE))	Waste HDPE includes dam liner material, flowlines and drip tubes from irrigation activities.	Construction Production / Extraction Decommissioning and Abandonment
Scrap Steel and Metal	Scrap steel and metal may include steel piping, valves and cabling.	Construction Production / Extraction Decommissioning and Abandonment
Timber	Scrap timber that is not suitable for reuse.	Construction Decommissioning and Abandonment
Plastic Liners	Waste plastic liners associated with sumps and turkeys nests dams.	Drilling Production / Extraction Decommissioning and Abandonment
Wiring	Electrical wiring and equipment not suitable for reuse.	Decommissioning and Abandonment

4.2 Santos GLNG Waste Management Facilities

Santos GLNG operates a number of specialised waste management facilities within the Santos GLNG Upstream Project Area. The key waste management facilities are described below.

4.2.1 Drilling Fluid Recycling Centres

The Drilling Fluid Recycling Centres (DFRC) receive drilling mud and fluid mixtures produced from drilling activities at well sites across the Santos GLNG Upstream Project Area. Using a centrifuge, the DFRC's separate the drilling mud from drilling fluid components, allowing for the re-use of the fluids in future drilling activities. There are currently two DFRC's servicing the Santos GLNG Upstream Project Area – one in the Fairview gas field and the other within the Roma gas field.

4.2.2 Springwater Fluid Treatment Facility

The Springwater Fluid Treatment facility is located within the Fairview gas field. The facility operates to receive and treat hydraulic stimulation fluids and flowback water generated from the stimulation of CSG wells within the Santos GLNG Upstream Project Area.

4.2.3 Wallumbilla Land Farm

The Wallumbilla Land Farm is located within the Roma gas field. It is designed to receive and remediate hydrocarbon contaminated soils resulting from Santos GLNG activities within the Roma gas field.

4.2.4 Reverse Osmosis Plants

The Fairview and Roma gas fields currently each possess a permanent Reverse Osmosis Plant (ROP). ROPs are also being installed at the three Hub Compression Stations currently under construction in Fairview and Roma. The ROPs significantly improve the quality of raw CS water generated across the gas fields by primarily reducing CS water salinity.

A number of mobile ROPs are also utilised across the Santos GLNG Upstream Project Area. The number of mobile ROPs operating at any one time is dependent on demand and the type of activity(s) being carried out.

4.2.5 Associated Water Amendment Facilities

Three Associated Water Amendment Facilities (AWAFs) are located within the Fairview gas field. These facilities receive and amend raw CS water from within the Santos GLNG Upstream Project Area. The water is chemically dosed and/or blended to create water of a suitable quality for re-use in Santos GLNG irrigation projects.

4.2.6 Regulated Dams

A number of regulated dams are presently in operation and/or under construction across the Santos GLNG Upstream Project Area. Regulated dams are predominantly used to aggregate CS water gathered from across the Santos GLNG Upstream Project Area. These dams act as holding / water balancing ponds, prior to the CS water being directed to either a ROP, AWAF, or other destination for treatment and/or for use. Regulated dams are also used to store permeate, amended water, ROC and brine (until such time other re-use or disposal methods are developed).

The *Santos GLNG Regulated Dam Register* can be consulted for detailed information regarding the regulated dams in operation (and under construction) across the Santos GLNG Upstream Project Area.

5.0 Management Strategy

5.1 Waste Management Hierarchy

Santos GLNG uses a sustainable approach to waste management. This approach revolves around a hierarchy, which provides a guideline to target waste production and disposal. The successful implementation of the waste hierarchy principles assist Santos GLNG to:

- Minimise waste volumes and the risk of causing harm to the environment; and
- Maximise operational efficiency and environmental performance.

The waste management hierarchy, from most preferable to least preferable, is illustrated in Figure 3. Each step of the hierarchy is discussed further in the following Sections.

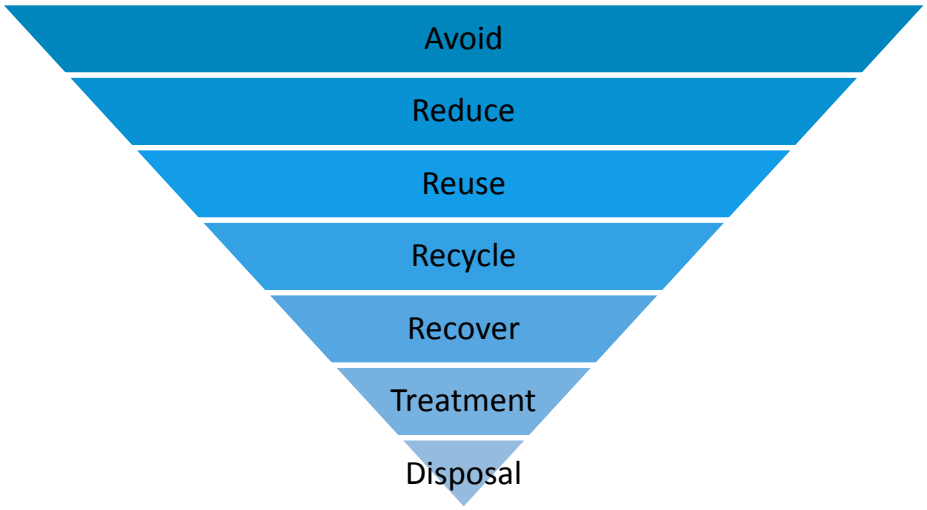

Figure 3: Waste Management Hierarchy

5.1.1 Waste Avoidance

Waste avoidance is primarily achieved during the planning and design of a project activity. At the concept stage, alternative approaches to materials used, construction and operational techniques and maintenance of a process can be undertaken to achieve a less resource intensive and more efficient process. Waste avoidance can also be encouraged through the proficient use of contracts management and setting of provisions related to waste targets.

5.1.2 Waste Reduction

Waste reduction is closely tied to waste avoidance as described above. However, waste reduction can be achieved at any stage of a project by reviewing existing processes and materials used, to achieve a more resource efficient process. Waste reduction also requires less energy than the waste management options listed further down the hierarchy by designing out waste before it is created. Waste itself is an indicator that systems and processes can be better designed.

5.1.3 Waste Reuse

Some waste streams are able to be reused with no or minimal treatment. Predominant reuse opportunities within the Santos GLNG Upstream Project Area include the return and reuse of packaging materials (i.e. pallets, metal or plastic containers, intermediate bulk containers etc.) and the reuse of untreated CS water (of a suitable quality) for dust suppression and construction and operational purposes. Where possible, reusable waste types are returned to the supplier.

5.1.4 Waste Recycling

Waste recycling includes the use of a waste stream as a raw material in a different process or as an alternative source of energy. Recycling is typically more energy intensive than reuse. The Santos GLNG Upstream Project Area produces a number of waste streams that are able to be recycled as previously outlined in Table 5. Some regulated wastes can also be recycled. Wastes that are to be recycled are typically sorted and stored on-site for collection by a licensed waste transporter. Depending on the waste type being recycled, the waste will be taken to the appropriate licensed facility for recycling (including Santos GLNG on-site waste management facilities).

5.1.5 Waste Treatment

Some waste types generated from Santos GLNG Upstream Project activities are able to be treated by Santos GLNG for reuse on-site or for safe transport and disposal. Existing wastes treated by Santos GLNG for reuse where appropriate and/or release to land, comprise (but not limited to):

- Hydrocarbon contaminated soils at the Wallumbilla Land Farm or in-situ where possible;
- Wastewaters, including:
    - Sewage at permanent or mobile STPs;
    - Stimulation fluids at the Springwater Fluid Treatment facility; and
    - Raw CS water.

For more detailed discussion on the treatment and management of wastewaters, including CS water, generated within the Santos GLNG Upstream Project Area, refer to the *Santos GLNG Upstream Land Release Management Plan* and the *Santos GLNG Gas Field Development Project Draft Environmental Management Plan 2014.*

5.1.6 Waste Disposal

Wastes that cannot be reused, recycled or treated for beneficial reuse will be segregated and stored in designated waste storage areas at each facility or activity location for collection by a waste transporter. Regulated wastes will be similarly segregated and stored for collection by a waste transporter licensed to transport them.

A number of waste disposal facilities are located within the immediate area surrounding the Santos GLNG Upstream Project Area as well as the surrounding region. Waste facilities used are dependent on the waste type being disposed of, the waste transporter, and the ability of the facility to receive the required volumes of waste. Frequently utilised waste disposal facilities by Santos GLNG include (but not limited to and subject to change):

- Dalby, Yuleba, Toowoomba, Maranoa Regional Council and Roma landfills;
- Injune and Roma Sewage Treatment Plants;
- JJ Richards waste facilities located at Clermont, Wacol, Toowoomba and New Chum; and

- ToxFree Facilities at Brisbane and Nerangba (Pinkenba, Coopers Plains and Narangba).

5.2 Waste Management Practices

In recognition of the waste management hierarchy, Santos GLNG implements a number of general waste management practices, consistent with the Santos *EHS04 Waste*. These practices ensure that Santos GLNG assets and activities that generate, receive (store) or dispose of waste having an understanding of:

- The types and quantities of waste generated, received and/or disposed; and
- Any risks associated with the transporting handling and disposal of these wastes.

These general practices are discussed in further detail below.

5.2.1 Waste Inventory

All assets and/or activities that generate, store or manage waste shall use a waste inventory to record the details of waste products. Inventory information is to include:

- The type and volume of each waste;
- The source of the waste; and
- The destination / fate of the waste.

Waste inventories enable the accurate assessment of waste data. Waste inventories therefore directly assist in the implementation of the waste avoidance and waste reduction principles of the waste hierarchy by enabling the review of the waste streams generated by specific processes and consequently identify opportunities for improvement. Waste inventories are also important to enable the accurate reporting of waste types and volumes to regulatory bodies as required (e.g. sustainability reporting).

5.2.2 Waste Storage and Handling

In addition to the specialised Santos GLNG Upstream Project Area waste facilities described in Section 4.2, wastes requiring transportation for recycling and/or disposal are stored within designated waste storage areas located at each asset / activity locations. Wastes are broadly segregated into general, recyclable and regulated waste types, with further segregation within each category (as required) for ease of identification and collection and to avoid contamination.

General wastes are typically stored within mixed general waste bins for removal. Putrescible wastes will be stored in covered containers wherever practicable, to minimise odours, exposure to Santos personnel and access to fauna.

General domestic recyclables are stored within mixed recycling bins for removal. Other recyclable waste types, such as certain plastics, scrap metals and containers will be segregated separately for ease of collection and management at the recycling facility.

Regulated wastes require more specific storage and handling requirements due to their potential to cause environmental harm and/or health and safety issues. Regulated wastes will be stored in appropriate containers / tanks that are appropriately labelled and where applicable, in accordance with the recommendations of relevant Safety Data Sheets, *AS1940:2004 The storage and handling of flammable and combustible liquids*, other relevant dangerous goods standards and the *Santos GLNG Upstream Chemical and Fuel Management Plan*. Regulated waste is to be stored within bunded waste management areas in line with the requirements of the Santos *EHS02 – Underground Storage Tanks*

and Bunds (EHS02), to ensure a secure location for the accumulation and storage of regulated wastes.

5.2.3 Waste Transport and Tracking

5.2.3.1 Waste Transport

Both hazardous (regulated) and non-hazardous wastes can be transported to points within the Santos GLNG Upstream Project Area (e.g. transference of waste to a local collection point) as well as directly off-site for management or disposal. General wastes and non-hazardous recyclable wastes can be removed offsite by a Santos GLNG representative, however, more preferably by a contracted waste collector.

While regulated wastes are able to be transported by Santos GLNG within the bounds of an area governed by an individual Environmental Authority (EA), beyond these boundaries, the waste must be handled and transported by a licensed waste transporter and tracking of the waste as required by legislation must occur (refer Section 5.2.3.2).

5.2.3.2 Waste Tracking

Santos GLNG will track the quantities and movement of general, recyclable and regulated wastes. General and recyclable wastes will be tracked using internal registers and waste inventories discussed in Section 5.2.1. The quantities and movement of regulated wastes will also be recorded using the internal waste inventories, but will primarily be tracked in accordance with the requirements of the EP Waste Regulation, using approved Waste Tracking Certificates (WTCs).

The use of WTCs ensure that all parties involved in the management of the waste take responsibility for its transportation and final disposal to prevent or minimise environmental impact. As the waste generator, Santos GLNG is required to provide the following information to the licensed waste transporter at the time of collection, and to the relevant administering authority within a prescribed timeframe:

- Waste generators name, address, local government area and contact details;
- Approval number under which the waste is being generated;
- Name and contact details of a Santos GLNG representative generating the waste;
- Date and time the waste is collected;
- The nominated receiving facility;
- Waste description;
- Waste volume;
- Waste category (i.e. solid, liquid or gas);
- Waste code (prescribed under the EP Waste Regulation);
- Waste origin code (prescribed under the EP Waste Regulation);
- UN number, class and packaging group (if applicable and as prescribed under the Australian Dangerous Goods Code); and
- Identify if the waste is being transported in bulk, otherwise the number of packages.

5.3 Typical Waste Management Measures for the Santos GLNG Upstream Project Area

Based on the waste management principles described in Sections 5.1 and 5.2, Table 6 summarises the waste management measures currently implemented by Santos GLNG to manage waste produced in the Santos GLNG Upstream Project Area, as described in Section 4.0.

Table 6: Typical Waste Management Measures for Typical Wastes Produced by Santos GLNG

Waste Name	Waste Description
Asbestos and SMF	Transported by a licensed contractor to a licensed regulated waste facility.
Batteries	Transported by a licensed contractor to a licensed regulated waste facility.
Brine and ROC	Stored in purpose built dams on-site. Some brine and ROC is currently used for re-injection. Brine final disposal options remain under assessment. Refer to CSG Water Management Plans for further detail.
CS Water	Stored temporarily in aggregation dams prior to reuse (ie dust suppression, construction purposes) or treatment.
Chemical Waste and Chemical Containers	Recycle where possible or transported by a licensed contractor to a licensed regulated waste facility.
Hydrocarbon Contaminated Soil	Left and managed / treated in-situ or transported to the Wallumbilla Land Farm for remediation.
Cooking Oil	Transported by a licensed contractor to a licensed regulated waste facility.
Drilling Fluid	Recycled where possible after treatment at a DFRC or removed to a licensed regulated waste facility by a licensed contractor.
Drilling Muds and Cuttings	Fit for purpose drill cuttings and muds are disposed in-situ or used in well lease construction and/or rehabilitation
General Recycling	Transported to a recycling facility for management and recycling.
Grease Trap Waste	Transported by a licensed contractor to a licensed regulated waste facility.
Green Waste (not contaminated with weeds)	Stockpiled or mulched to be spread for rehabilitation and erosion control or placed in surrounding areas to provide fauna habitat.
Green Waste (contaminated with weeds)	To be managed in accordance with the local government recommendation. This may include off-site disposal or in-situ management.
Hydrostatic Test Water	Disposed of to land, otherwise treated for reuse.
Intermediate Bulk Containers	Transported by a waste contractor for recycling and management.
Medical and Clinical Waste	Sharps and biohazard bins are transported by a licensed contractor to a licensed regulated waste facility.
Oily Filters, Rags, Absorbents	Transported by a licensed contractor to a licensed regulated waste facility.

Waste Name	Waste Description
Oily Water and Oily Water Treatment Sludge	Transported by a licensed contractor to a licensed regulated waste facility.
Pipeline Tape Wrap	Transported by a waste contractor for disposal.
HDPE	Transported by a waste contractor for recycling and management.
Putrescible and other domestic wastes	Transported by a waste contractor for disposal.
Permeate	Injected into the Gubberamunda formation, to replenish groundwater volumes and for use by the greater regional community. Refer to CSG Water Management Plans for further details.
Rock Mesh	Transported by a waste contractor for disposal.
Scrap Steel and Metal	Transported by a waste contractor for recycling and management.
Sewage effluent	Treated and disposed to land in-situ or transported by a licensed contractor to a licensed regulated waste facility.
Stimulation Flowback Water	Stored for reuse or where required, treated at the Springwater Fluid Treatment Facility for reuse.
Timber	Transported by a waste contractor for disposal.
Treatment Filters and Membranes	Transported by a waste contractor for disposal.
TEG / Glycol / Coolant	Transported by a licensed contractor to a licensed regulated waste facility.
Tyres	Transported by a licensed contractor to a licensed regulated waste facility for recycling.
Used Spill Kits	Transported by a licensed contractor to a licensed regulated waste facility.
Waste Oil (Clean waste oil)	Transported by a licensed contractor to a licensed regulated waste facility for recycling.
Waste Plastic Liners	Transported by a waste contractor for recycling and management.
Wellhead Separator Waste (Coal Fines)	Transported by a waste contractor for disposal.

5.4 Training

Santos GLNG Project personnel carrying out works that generate, transport, store, treat and/or dispose wastes within the Santos GLNG Upstream Project Area undergo a basic site-specific induction which includes an outline of the waste management requirements (and other environmental issues) on-site. Applicable training suited to the different roles and responsibilities (Section 2.0) is to be undertaken in accordance with the appropriate Santos Standards including *EHSMS06 Training and Competency and EHS04 Waste.*

Regular toolbox meetings are also held to reinforce key waste management principles to maintain compliance with approval regulatory requirements and to reinforce solutions or increase awareness of any waste management related issues that arise during the course of exploration, construction, operations, decommissioning and rehabilitation.

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6.0 Evaluation and Review

6.1 Evaluation

The implementation and effectiveness of this management plan and its associated procedures will be regularly assessed to ensure:

- Santos GLNG is demonstrating compliance with legal and landholder obligations;
- The overall management strategy remains relevant and up to date; and
- The plan and procedures adequately manage the environmental issue.

Effectiveness will be assessed by a number of methods as shown in Table 7.

Table 7: Methods to Assess Procedural Effectiveness

Assessment Tool	Description
Checklists – Santos GLNG Compliance Management System	Checklists, developed to reflect procedural requirements / outcomes will be used by individual Santos GLNG Departments to assess and manage compliance. The results of the checklists will be evaluated for trending non-compliances that may be resolved through procedural change or by implementing another measure or process.
Audits	Conduct internal and third party audits to formally assess the level of compliance with both regulatory requirements and with Santos GLNG procedures. Audit outcomes are used to develop corrective actions which may include changes to procedures.
Review of Incidents	A review of internal incidents, near misses or hazards will be undertaken to identify recurrences of similar incident types. This may highlight a requirement for a change in an existing procedure, require the development of a new procedure or by implementation of another measure or process to address the recurring issue.
Review of Data	Analyse all relevant data collected for negative and/or undesirable trends that may be prevented by procedural changes or by implementing another measure or process.

6.2 Review

The WMP is a living document and shall be reviewed at least every three years or sooner if any of the following occur:

- The plan is not adequately managing the issue (refer Section 6.1);
- Legislative requirements change;
- The area of activity changes;
- A new waste type is to be generated; and/or
- New procedures relating to waste management are developed.

Reviews and changes to the WMP are to be communicated to relevant Santos GLNG Project personnel.

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7.0 Definitions

Term	Definition
Associated Water Amendment Facility	A Santos GLNG facility that receives and treats raw CS water, using chemical dosing, to a standard where the water can be reused in accordance with approval conditions.
Checklist	Checklists assist in assessing the implementation of a Procedure. Checklists contain a list of key items required, things to be done, or points to be considered and are a tool to assess compliance with a Procedure.
Dangerous Goods	Goods specified as dangerous goods in the Australia Dangerous Goods Code.
Drilling Fluid Recycling Centre	A Santos GLNG facility that receives drilling mud and fluid mixtures and acts to separate the fluid and muds via a centrifuge.
Licensed Waste Transporter	A commercial waste transporter authorised or acting under, the required authority for the activity.
Management Plan	Management Plans are specific to an environmental issue and/or topic. They primarily serve to provide a high level overview of the legislative and approval requirements and the Santos GLNG management strategy in place for the relevant environmental issue. Management Plans are also suitable for providing environmental regulators an overview of Santos GLNG environmental management, and in many cases, may be a direct requirements of an environmental approval.
Procedure	Procedures are designed to assist in the implementation of the Management Plan, by prescribing a series of processes and actions for a specific topic.
Putrescible Waste	Waste that can be readily decomposed through the action of microorganisms, such as food wastes.
Regulated Waste	Commercial or industrial waste or construction or demolition waste that contains a substance, a chemical compound containing an element of a substance or anything containing residue of a substance mentioned in Schedule 1 of the *Environmental Protection (Waste Management) Regulation 2000* or Schedule 7 of the *Waste Reduction and Recycling Regulation 2011.*
Reverse Osmosis Plant	A manufacturing plant where the process of Reverse Osmosis takes place – a liquid filtering process in which a more concentrated (contaminated) liquid is forced through a semi-permeable membrane that blocks most dissolved or suspended contaminants.
Santos GLNG Upstream Project Area	Comprises all Santos GLNG exploration and production tenements of the Arcadia, Fairview, Roma and Scotia gas fields.
Trackable Waste	Regulated wastes listed in Schedule 1 of the *Environmental Protection (Waste Management) Regulation 2000.*
Waste	Includes any solid, liquid or gas (or combination thereof) that is left over, surplus, or an unwanted by-product (whether of value or not).

Waste Management Hierarchy	The waste management hierarchy is a nationally and internationally accepted guide for prioritising waste management practices with the objective of achieving optimal environmental outcomes. It sets out the preferred order of waste management practices, from most to least preferred being avoid, reduce, reuse, recycle, recover, treat and disposal.
Waste Tracking Certificate	The Waste Tracking Certificate is in the form approved by the administering authority and is designed to track the movement of 'trackable waste' under the *Environmental Protection Regulation 2008*. The form captures details of the waste generator and the waste type generated, the waste transporter, and the place where the waste is received to be treated and/or disposed of.

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8.0 References

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