25. WASTE MANAGEMENT

The focus of this chapter is to describe waste management strategies for the entire PNG LNG Project. Project waste management will rely on new project facilities or existing co-venturer waste management areas as, in general, there are no suitable waste management facilities available at any of the various localities of the PNG LNG Project. Related to this and the general isolation of the areas in which the project is located, waste incineration is a key component of Esso's plans to manage wastes that cannot be recycled or reused.

This chapter addresses solid and liquid, restricted and non-restricted waste management across the project. It does not include licensed wastewater and sewage discharges, licensed air emissions, waste heat and energy, cut-and-fill material disposal or reuse, dredged material disposal, or vegetation clearance and disposal or reuse, which are described elsewhere in the EIS.

Section 25.1 outlines the relevant legislation, guidelines and policies. It also describes waste management strategies and processes to be employed, including waste prevention, recycling and reuse, treatment and disposal, restricted waste management, waste storage, transportation and monitoring.

Section 25.2 details the waste types that will be generated during construction, drilling and operations and Section 25.3 provides estimates of waste quantities.

Section 25.4 describes the waste management facilities to be used across the project to deal with the wastes described and quantified in Sections 25.2 and 25.3.

The terms 'restricted waste' and 'non-restricted waste' are used throughout this chapter and are defined as follows:

- Restricted waste refers to wastes which are ignitable (i.e., they burn easily), corrosive, reactive (e.g., explosive) or toxic. Additionally, certain wastes may be listed as hazardous by government authorities or applicable international conventions and should be considered restricted. Restricted wastes may be solid, semi-solid, liquid, or contained gases. This category also refers to 'pathogenic' materials (e.g., bacteria, viruses, or parasites) which are capable of causing illness or disease in humans, animals, plants or other organisms.
- Non-restricted wastes are materials that do not pose an immediate hazard to health, safety and/or the environment.

25.1 Relevant Legislation, Guidelines and Policies

25.1.1 PNG Legislation

The principal PNG legislation and guidelines that refer to waste management are the Oil and Gas Act (s. 87(c) and s. 124(f)) and the Environmental Code of Practice for Sanitary Landfill Sites PNG 2001. The latter is addressed in more detail in Section 25.1.1.1, PNG Environmental Code of Practice for Sanitary Landfill Sites.

Section 87(c) of the Oil and Gas Act states that an applicant for a petroleum processing facility licence must include a description of the waste disposal procedure, while s. 124(f) places a more general duty on licensees of all types to prevent pollution to water bodies by 'any…waste.'

25.1.1.1 PNG Environmental Code of Practice for Sanitary Landfill Sites

The Environmental Code of Practice for Sanitary Landfill Sites applies to facilities on public and private land and is administered by the Department of Environment and Conservation. Under the code, Class 1 sites refers to municipal facilities that are mechanised, receive greater than 1,000 tonnes per day, serve towns with populations of greater than 20,000 people and have the capacity to receive and treat special waste.

Class 2 sites are manually operated municipal facilities (do not use compactors or graders), do not have special capacity to treat or dispose of special wastes, treat less than 1,000 tonnes per day and serve towns of between 4,000 to 20,000 people.

Class 3 sites are not serviced by municipal authorities but instead are managed privately by institutions, companies or individuals. Like Class 2 sites, they are manually operated.

In addition, Class 1 and Class 2 landfill sites require preparation of an environmental impact assessment and grant of a landfill licence. In the event that landfill licences are required for the PNG LNG Project, this EIS would fulfil the requirements for impact assessment to allow grant of the landfill licences although further site-specific detail may be provided at a later date as part of the project environmental management plan.

The project landfill sites will be managed privately by Esso and will be capable of receiving and treating 'special waste'[1].

Aspects of the PNG Environmental Code of Practice for Sanitary Landfill Sites that will be considered by the project in the design, construction, operations and closure of project landfills include direction on site selection, capacity, hydrogeological features, environmental, safety and health risks.

In the course of preparing the detailed waste management plans for the project environmental management plan, Esso will consult with the Department of Environment and Conservation on the requirements of the code of practice as it applies to the construction and operations of project landfills.

25.1.2 International Conventions and Agreements

International waste conventions to which Papua New Guinea is a signatory and with which the project will comply are the:

- Waigani Convention 1995 (PNG Harbours, 2004), which bans the import of restricted and radioactive wastes and controls transboundary movements and management of restricted wastes within the South Pacific region. The Waigani Convention enables Australia to receive

[1] It has been assumed that 'special wastes' fall into the category of 'restricted wastes' as defined earlier in this chapter. This assumption will be confirmed with the Department of Environment and Conservation during preparation of the project environmental management plan.

restricted wastes from South Pacific Forum Island countries, such as Papua New Guinea, where there is no infrastructure to recover or dispose of such waste.

- Basel Convention 1995 (Kare, 1995), which controls transboundary movements of restricted wastes and disposal worldwide.

As the project is seeking external institutional lender funding, the International Finance Corporation (IFC) environmental guidelines on waste management will be considered. The IFC guidelines are further discussed in Section 25.1.3, International Finance Corporation Guidelines for Waste Management.

25.1.3 International Finance Corporation Guidelines for Waste Management

In addition to ExxonMobil's own waste management standard (described in Section 25.1.5, ExxonMobil Waste Management Studies and Standards) and the ExxonMobil environment policy (see Figure 1.5), which will guide waste management, the project will refer to IFC guidelines during project design to develop waste management guidance for the construction, drilling and operations phases, including guidance for major project contractors. For example, waste incineration is proposed at a number of project sites to reduce the volume to be transported or disposed of in a landfill. Due to very limited waste management facilities and the remoteness of project locations, incineration is the most viable primary waste minimisation technique to be employed by the project. High-temperature incinerators for project waste disposal will be used in accordance with practices to reduce the emissions of persistent organic pollutants as outlined in the Stockholm Convention (UNEP, 2004).

The project will comply with the relevant and applicable parts of the IFC Environmental, Health, and Safety Guidelines – General EHS Guidelines: Environmental Waste Management (IFC, 2007k) [M103].

For the design of new waste management facilities, the project will comply with the relevant and applicable parts of the IFC Environmental, Health, and Safety Guidelines – Waste Management Facilities (IFC, 2007l) [M103].

25.1.3.1 Waste Avoidance or Minimisation

Processes will be designed and operated to avoid or minimise the generation of wastes and the hazards associated with the wastes generated in accordance with the following strategies:

- Substituting raw materials or inputs with less hazardous or toxic materials or with those where processing generates lower waste volumes.
- Applying processes that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls.
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out of date, off specification, contaminated, damaged, or excess to plant needs.

- Instituting procurement measures that recognise opportunities to return usable materials, such as containers, and that prevents the over-ordering of materials.
- Minimising restricted waste generation by implementing stringent waste segregation to prevent the co-mingling of non-restricted and restricted waste.

The project waste management procedures will be developed to enable the implementation of waste avoidance or minimisation measures.

25.1.3.2 Recycling and Reuse

In addition to the implementation of waste avoidance or minimisation strategies, the total amount of waste should be reduced through the implementation of recycling plans, which will consider the following elements:

- Evaluation of waste production processes and identification of potentially recyclable materials.
- Identification and recycling of products that can be reintroduced into the process or activity at the site.
- Investigation of external markets for recycling by other industrial processing operations located in the vicinity of the facility (e.g., waste timber provision to landowners).
- Establishing recycling objectives and formal tracking of waste generation and recycling rates.
- Providing training and incentives to employees to meet objectives.

Potential recycling or reuse of wastes includes drums, glass, scrap metal, paper and cardboard. The project waste management procedures will be developed to enable the implementation of waste recycling and reuse measures; however, recycling markets in Papua New Guinea are limited, particularly in the upstream project areas.

25.1.3.3 Treatment and Disposal

Waste materials generated after the implementation of feasible waste avoidance, minimisation, recycling and reuse measures will be treated and disposed of in accordance with best practices, and all measures will be taken to avoid potential impacts to human health and the environment. Selected management approaches at each site will be consistent with the characteristics of the waste and local regulations and may include one or more of the following:

- Onsite or offsite biological, chemical, or physical treatment of the waste material to render it non-restricted prior to final disposal.
- Treatment or disposal at permitted facilities specially designed to receive the waste. Examples include composting operations for organic non-restricted wastes; properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; and other methods known to be effective in the safe, final disposal of waste materials, such as bioremediation.

25.1.3.4 Restricted Waste Management

Restricted wastes will be segregated from non-restricted wastes. If generation of restricted waste cannot be avoided through the implementation of the above general waste management

practices, its management will focus on the prevention of harm to health, safety, and the environment, according to the following additional principles:

- Understanding potential impacts and risks associated with the management of any generated restricted waste during its complete life cycle.
- Ensuring that contractors handling, treating, and disposing of restricted waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled.
- Ensuring compliance with applicable local and international regulations, conventions and standards (e.g., Waigani and Basel conventions for the transfer of restricted waste across national borders).

The project waste management procedures will be developed to enable the implementation of restricted waste management processes.

25.1.3.5 Waste Storage

Restricted waste will be stored so as to minimise the possibility of accidental releases to air, soil, and water resources via implementation of the following principles:

- Storage in a manner that prevents the co-mingling of, or contact between incompatible wastes and that allows for inspection between containers to monitor leaks or spills.
- Storage in closed containers away from direct sunlight, wind and rain.
- Usage of secondary containment systems constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment.
- Usage of secondary containment wherever liquid wastes are stored in volumes greater than 220 L. The available volume of secondary containment will be at least 110% of the largest storage container or 25% of the total storage capacity (whichever is greater) in that specific location.
- Provision of adequate ventilation where volatile wastes are stored.

Restricted waste storage activities will be subject to special management actions, will be conducted by employees who have received specific training in handling and storage of restricted wastes, and will include:

- Providing readily available information to employees on chemical compatibility, including labelling each container to identify its contents.
- Limiting access to restricted waste storage areas to employees who have received proper training.
- Clearly identifying (i.e., labelling) the area, including documentation of its location on a facility map or site plan.
- Conducting periodic inspections of waste storage areas and documenting the findings.
- Preparing and implementing spill response and emergency plans to address their accidental release.

The project waste management procedures will be developed to enable the implementation of restricted waste storage processes.

25.1.3.6 Transportation

Onsite and offsite transportation of waste will be undertaken in a manner that minimises the possibility of spills, releases, and exposures to employees, the community and the environment. The waste management plan will define the processes and standards applying to the transport of waste.

All waste containers designated for offsite shipment will be secured and labelled with the contents and associated hazards, properly loaded on the transport vehicles before leaving the site, and accompanied by a transport certificate (i.e., manifest) that describes the load and its associated hazards and destination. The waste haulage distances for upstream construction waste is discussed in Section 25.4 Waste Management Areas.

25.1.3.7 Monitoring

Monitoring activities associated with the management of restricted and non-restricted waste will include:

- Regular visual inspection of all waste collection equipment and storage areas for evidence of accidental releases and to verify that wastes are properly labelled and stored. When significant quantities of restricted wastes are generated and stored on site, monitoring activities will include:
  - Inspection of vessels for leaks, drips or other indications of loss.
  - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors.
  - Verification of locks, emergency valves, and other safety devices for easy operation.
  - Checking the operability of emergency systems.
  - Documenting results of testing for integrity, emissions, or monitoring stations (e.g., air, soil, vapour, or groundwater).
  - Documenting any changes to the storage facilities and any significant changes in the quantity of materials in storage.
- Regular assessments of waste segregation and collection practices.
- Tracking of waste generation trends by type and amount of waste generated.
- Characterising waste at the beginning of the generation of a new waste stream, and periodically documenting the characteristics and proper management of the waste, especially restricted wastes.
- Keeping manifests or other records that document the amount of waste generated and its destination.
- Regularly assessing contractor treatment and disposal services, including reuse and recycling facilities when large quantities of restricted wastes are managed by third parties. Where

practicable, assessments will include site visits to the treatment, storage and disposal locations.

- Where appropriate, regular monitoring of groundwater quality in cases of restricted waste onsite storage or pretreatment and disposal.
- Monitoring records for restricted waste collected, stored, or transported will include:
  - Name and identification number of the material or materials composing the restricted waste.
  - Physical state (i.e., solid, liquid, gaseous or a combination of two or more of these).
  - Quantity (e.g., by weight or volume and number of containers).
  - Waste shipment tracking documentation, including quantity and type; date dispatched; date transported; date received; and the name of the originator, the receiver and the transporter.
  - Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the restricted waste.
  - Location of each restricted waste within the facility and the quantity at each location.

The project waste management procedures will be developed to enable the implementation of waste monitoring processes.

25.1.4 US EPA Standards

Emissions from new incinerators will meet the intent of the emission limits in US EPA 40 CFR Part 60, Standard of Performance for New Stationary Sources (NSPS), including Subpart AAAA, Standards of Performance for Small Municipal Waste Combustion Units, or Subpart CCCC, Standards of Performance for Commercial and Industrial Solid Waste Incineration Units (EPA US, 2008), as applicable [M103].

25.1.5 ExxonMobil Waste Management Studies and Standards

ExxonMobil approaches waste management in a strategic sense through its corporate standards and, more directly, through specific studies either prepared in-house or commissioned through specialist consultants. The studies help to define a consistent approach and the issues to be addressed during all aspects of the design and operation of the project by both employees and contractors. The corporate standards are described more fully in Section 25.1.3.1, Corporate Standards.

25.1.5.1 Corporate Standards

ExxonMobil has developed a comprehensive series of environmental standards as one of the key means of implementing its corporate environment policy. Similar standards have been developed for health and safety. The waste management standard has many parallels with the IFC guidelines and applies a very similar hierarchy of reduce, reuse, recycle and treat/dispose.

The objective of the standard is to manage the environmental, safety and human health impacts associated with waste based on sound science.

The standard does not specify technologies or equipment to be used. Instead, it formalises a series of waste management planning activities for completion at specified times during project development. The basic requirements of the waste management standard are:

- Comply with applicable host-country regulatory requirements and legally binding agreements related to waste management.
- Design and execute projects to meet the applicable criteria of the standard.

The standard applies to all ExxonMobil-operated projects (i.e., both greenfield and brownfield projects) and projects-associated drilling activities.

25.1.5.2 Waste Management Plans

The determination of waste types, quantities of waste and waste ownership (i.e., those individuals or entities responsible for managing the waste) are critical to developing sound, efficient strategies. These and other aspects are components of a preliminary waste management plan that will be prepared leading into FEED. At the end of FEED, that plan will be upgraded (incorporating engineering and cost details produced during FEED studies) and incorporated into the environmental management plan as an appendix or adjunct plan.

The preparation and implementation of a project waste management plan will be a key function in the waste management process. Therefore, the operator will prepare guidance waste management plans for each major construction contractor to enable those contractors to prepare detailed working waste management plans framed to implement the objectives outlined in this chapter. The guidance waste management plans will be detailed in the environmental management plan.

The operations phase will develop a waste management plan for detailed implementation throughout operations.

The organisational structure required to facilitate and assess implementation of waste management plans will be identified in the environmental management plans.

25.1.6 Project Objectives

Arising from Section 25.1.3, International Finance Corporation Guidelines for Waste Management and the requirements of the PNG Government (in particular the Environmental Code of Practice for Sanitary Landfill Sites PNG 2001) and international conventions, the project objectives for waste management are to:

- Mitigate the environmental, safety and human health impacts associated with waste management based on sound science.
- Fulfil unambiguous ExxonMobil expectations to appropriately and prudently manage all wastes.
- Ensure appropriate systems and facilities are in place to handle and treat the anticipated waste streams.
- Reduce impacts associated with waste generation and management through the development of comprehensive and rigorous waste management.

- Comply with applicable waste management-related PNG regulatory requirements and codes of practice and relevant international laws, conventions, and regulations in the case of waste exports (i.e., the Basel and Waigani conventions).
- Ensure unavoidable waste is either treated to produce a non-restricted material or disposed of at a project waste management facility in an approved manner.
- Establish and document, in a timely manner, waste management systems, processes, procedures, and facilities that will be incorporated into the design, construction and operation of the project.

The above objectives will be achieved through:

- Undertaking a comprehensive and methodical waste management study during FEED that addresses all aspects of planned construction, operation, maintenance, decommissioning and closure to optimise all inter- and intra- facility waste management approaches.
- Definition of those facilities and processes necessary to be put in place to achieve the objectives.
- Preparation of site- and contractor-specific waste management plans incorporating recommendations of the waste management study to encompass each waste's full life cycle and the entire suite of management options, including generation avoidance, reuse, recycling, handling, storage, transportation, treatment or processing, and disposal.
- Optimisation of the selection and use of materials that will avoid or minimise the production of wastes.
- Maximisation of the reuse or recycling of waste materials where appropriate.
- Proper classification and characterisation of wastes.
- Proper and prudent disposal of non-reusable, non-recyclable and non-treatable wastes at project waste management facilities.
- Provision of required handling, transportation, and storage capabilities for each major waste type or stream.
- Implementation of appropriate waste tracking procedures.
- Monitoring and inspection of waste management-related facilities and activities to ensure compliance with the project waste management procedures.

25.2 Waste Types

25.2.1 Construction

Waste types generated at the upstream and LNG Facilities construction sites (including the offshore pipeline construction) will include the non-restricted and restricted wastes described in Table 25.1.

Table 25.1 Waste types that will be generated during upstream and LNG Facilities site construction

Waste Type	Comment
Non-restricted	
Ash from incinerators	There is an emphasis throughout the project of incineration of all combustible waste to reduce disposal volumes. Ash from non-restricted waste is assumed to be non-restricted.
Construction debris (e.g., wood, scrap metal, glass, insulation, plastic)	Incineration to reduce waste volumes will be a standard waste management process for construction waste where possible. Metal waste will be segregated and disposed to landfill if not recycled.
Domestic garbage	Incineration to reduce waste volumes will be a standard waste management process for domestic garbage where possible.
Domestic sewage sludge	The large project sewage treatment plants will include sludge dewatering facilities to enable sludge incineration.
Tyres	These will be debeaded, shredded and incinerated.
Redundant electrical goods	Once stripped of restricted materials, redundant electrical goods will be segregated and disposed to landfill.
Empty drums and containers	These will be crushed and cleaned of materials and disposed to landfill if not recycled. Combustible containers will be incinerated.
Empty gas cylinders	These will be segregated and returned to the supplier.
Restricted	
Batteries (lead acid)	Return to manufacturer will be investigated during FEED.
Empty drums and containers	These will be cleaned of restricted materials and disposed to landfill if not recycled. Combustible containers will be incinerated.
Medical waste	This will be segregated then incinerated, following development of handling procedures. The ash will be disposed to landfill as non-restricted waste.
Oily debris	This will be incinerated.
Redundant paint and waste	These will be incinerated.
Plastic materials	These will be incinerated.
Used lubricating oils	These will be incinerated.
Unused, spent, expired and contaminated solvents, chemicals and additives	These will be incinerated following handling and emissions procedures that will be developed.

25.2.2 Drilling

Development drilling will consist of a number of drilling programs throughout the project life (see schedule in Figure 1.3). The same types of wastes listed in Table 25.1 will be generated during the drilling programs, although generally in smaller volumes. Such waste will be transported to project waste management areas for treatment and disposal.

Additionally, drill cuttings and waste water-based drilling muds from the well site mud pit will be transported and disposed of in a designed excavated pit at the Hides Gas Conditioning Plant. Other alternatives are being investigated to determine if there are any other feasible options available, such as reinjection into a suitable formation in the valley below Hides Ridge.

Disposal of drilling cuttings and waste water-based drilling muds during the development of the Angore wells will also be at the designed excavated pit at the Hides Gas Conditioning Plant. Waste drill cuttings and muds from the Juha wells will be disposed of in a designed excavated pit at the Juha Production Facility.

Horizontal directional drilling techniques will be used at some watercourse crossings. A drilling muds and cuttings management system, including drill cuttings settlement and slurry containment pits, will be implemented.

25.2.3 Operations

Waste types generated at the upstream and LNG Facilities sites during operations will include the non-restricted and restricted wastes described in Table 25.1 and the additional wastes described in Table 25.2.

Table 25.2 Additional waste types that will be generated during operation of the upstream facilities and the LNG Facilities site

Waste Type	Comment
Non-restricted	
Spent molecular sieve adsorbent Ceramic ball support	This will be analysed to confirm that no restricted material has adhered to the adsorbent and will then be disposed of as a non-restricted waste to landfill. The molecular sieve itself is made of a zeolite-and-binder mixture that is inert and can be classified as synthetic clay.
Restricted	
Unused, spent, expired and contaminated solvents, chemicals and additives (e.g., MEG, TEG, corrosion inhibitor, oxygen scavenger)	These will be incinerated following the development of handling and emissions procedures.
Oil sludge from the process, for example, pig receiver condensate sludge, slug catcher sludge and separator sludge	These will be collected in slops tank and reintroduced to processing.
Sludge removed from the MEG and TEG regenerators during maintenance programs	These will be incinerated.
Sludge removed from the wastewater ponds and sumps during maintenance programs.	These will be incinerated.
Sludge removed from the amine facilities during maintenance programs	This will be incinerated.
Naturally occurring radioactive material (NORM)	Over time, NORM can form a scale on gas processing equipment. Disposal of NORM-contaminated processing pipes and vessels requires specific monitoring, cleaning and disposal programs to be developed. It is not known whether the gas fields contain potentially NORM-generating gas. This will be determined as gas production proceeds and will be monitored. If there is a need to dispose of NORM material, one option is to export the waste to Australia's regulated NORM waste facilities, which currently service the Australian oil and gas industry. If export does occur, the requirements of the Waigani and other relevant international conventions will be followed.

Table 25.2 Additional waste types that will be generated during operation of the upstream facilities and the LNG Facilities (cont'd)

Waste Type	Comment
Restricted (cont'd)	
Mercury	Small amounts of naturally occurring mercury will be removed from the feed gas using an adsorbent material (see Section 4.2.2, LNG Plant). The adsorbent may be removed periodically for disposal. The adsorbent will be transferred offsite to a disposal facility where the mercury will be recovered. If the mercury adsorbent is exported for disposal, the Waigani and other relevant international waste disposal conventions will be followed. Mercury levels in the feed gas are extremely low, and the adsorbent may not need to be replaced during the life of the project.

25.3 Waste Quantities

An estimate of the waste quantities that will be generated during upstream construction and operations is shown in Table 25.3.

The largest quantities of non-restricted wastes generated will be general waste, pallets and other wood material, food waste, paper, cardboard, plastics, drums, sewage sludge and scrap metal. Non-restricted wastes will mostly be disposed of to landfill, in some cases after incineration.

The source location of these wastes generated include: construction and operations sites from the Juha drill pads to the LNG Plant, including camps, drilling operations, pipeline ROWs, Hides Gas Conditioning Plant, Juha Production Facility, the associated oil field production facilities at Gobe, Kutubu and Agogo and access ways.

The largest quantity of restricted waste generated will be approximately 1,650 tpa of oily rags, which will be incinerated.

The drilling rig will generate drill cuttings at each wellpad. The quantity of drill cuttings that will be generated is estimated to be 600 m^3/well.

As drilling progresses, shale shakers remove drilling mud from the drill cuttings. Approximately 2,400 m^3/well of drilling mud will be used. The recovered mud is returned to the mud tank and reused. Waste drilling mud will also be disposed away from Hides Ridge.

Table 25.3 Upstream construction and operations waste generated, estimated quantities and disposal methods

Waste Type	Treatment at Camp, Work Site or Waste Management Area	Output	Storage	Transport	Quantity Per Year	Disposal Method
Food waste	Incinerator	Ash	Bins	Covered truck	8,000 m^3	Landfill
Plastics	Bundling	Plastics	Skips	Covered truck	1,650 m^3	High-temperature Incinerator, then landfill
Pallets and other wood material	Incinerator	Ash	Bins	Covered truck	15,000 m^3	Landfill
Drums (metal and plastic)	Sorting and segregation	Drums	Skips	Covered truck	3,000 m^3	Clean and reuse, or incinerate (residual chemicals) and/or crush, then landfill
Domestic sewage	Sewage treatment plant dewatering	Dewatered sewage sludge	Sewage treatment plant	Vacuum truck	1,800,000 L	High-temperature incinerator, then landfill
Medical waste	Incinerator	Ash	Bins	Covered truck	3 t	Landfill
General waste	Sorting and segregation	Drums	Skips	Covered truck	15,000 t	Landfill
Glass	Sorting and segregation	Drums	Skips	Covered truck	540 m^3	Recycled or landfill.
Scrap metal	Sorting and segregation	Skips	Skips	Covered truck	2,500 t	Recycled or landfill
Paper and cardboard	Sorting and segregation	Bundles	Skips	Covered truck	4,000 m^3	Recycled or landfill
Oily rags	Sorting and segregation	Bundles	Skips	Covered truck	1,650 t	High-temperature incinerator
Waste oil	Sorting and segregation	Drums	Drums	Covered truck	5,100 L	Recycled or high-temperature incinerator
Oil filters	Sorting and segregation	Bins	Skips	Covered truck	500 total	High-temperature incinerator

Table 25.3 Upstream construction and operations waste generated, estimated quantities and disposal methods (cont'd)

Waste Type	Treatment at Camp, Work Site or Waste Management Area	Output	Storage	Transport	Quantity Per Year	Disposal Method
Solvents	Sorting and segregation	Drums	Skips	Covered truck	180 L	High-temperature incinerator.
Batteries	Sorting and segregation	Bins	Skips	Covered truck	3,000 total	Return to manufacturer will be investigated

25.4 Waste Management Areas

The project will use the following treatment and disposal techniques at designated project waste management areas as required:

- High temperature incineration.
- Engineered landfill.
- Sewage treatment plant sludge dewatering (for incineration).
- Tyre debeading and shredding (prior to incineration or recycling).
- Metal drums cleaned and crushed before disposal to landfill.
- Electrical equipment and parts stripped of restricted materials, then shredded before landfill disposal.
- Drill cuttings treated at the drill rig to recover drilling mud, then transported to the Hides Gas Conditioning Plant for disposal.

Project waste management areas will be located at Kopi, Gobe, Hides and the LNG Facilities site. These will cover the regions of Omati to Samberigi, Samberigi to Kutubu, and Kutubu to Hides, and the LNG Facilities site respectively. The waste management infrastructure to be located at each waste management area is shown in Table 25.4. The waste management areas will undertake waste treatment, high-temperature incineration and landfill disposal. Table 25.4 also shows the existing Oil Search Limited waste management infrastructure in the project area, as well as new infrastructure required.

Table 25.4 Waste management infrastructure

Infrastructure Type	Existing Oil Search Facility	Upgraded Existing Oil Search Facility	New Facility	Operator During Construction	Operator After Construction
Kopi					
Waste management area	Y	N	Y	Esso	Oil Search
High-temperature incinerator (est. capacity of 20 m^3/d)	N	N	Y	Esso	Oil Search
Tyre debeader	N	N	Y	Esso	Oil Search
Industrial shredder	N	N	Y	Esso	Oil Search
Gobe					
Waste management area	Y	Y	N	Oil Search	Oil Search
Drum cleaner and crusher	Y	Y	N	Oil Search	Oil Search
Engineered landfill	Y	Y	N	Esso	Oil Search
Hides					
Waste management area	N	N	Y	Esso	Esso
High-temperature incinerator (est. capacity of 20 m^3/d)	N	N	Y	Esso	Esso
Drum cleaner and crusher	N	N	Y	Esso	Esso
Tyre debeader	N	N	Y	Esso	Esso
Industrial shredder	N	N	Y	Esso	Esso
Oil processor	N	N	Y	Esso	Esso
Engineered landfill	N	N	Y	Esso	Esso
LNG Facilities					
Waste management area	N	N	Y	Esso	Esso
High-temperature incinerator (est. capacity of 20 m^3/d)	N	N	Y	Esso	Esso
Drum cleaner and crusher	N	N	Y	Esso	Esso
Tyre debeader	N	N	Y	Esso	Esso
Industrial shredder	N	N	Y	Esso	Esso
Oil processor	N	N	Y	Esso	Esso
Engineered landfill	N	N	Y	Esso	Esso

Construction contractors will be responsible for the proper transport and handling of all waste that they produce, in accordance with the operator's direction, which will be detailed in the environmental management plan. This will mean that waste from upstream construction work

sites and camps will have to be hauled long distances. Table 25.5 shows the haulage distances to waste management areas from project sites. Contractors will be responsible for delivering their sorted and segregated waste to one of the three regional waste management areas at Kopi, Gobe and Hides (Figure 20.1). Once the waste is delivered, it will be treated and disposed of by the operator of the waste management area. If this ultimate disposal involves the transportation of waste material between waste management areas (e.g., incinerator ash from Kopi to Gobe for landfill disposal), the waste haulage will be undertaken by the operator of the waste management area.

Table 25.5 Waste haulage distances for upstream construction waste

Worksite or Camp	Waste Management Area	Waste Type Hauled	Haulage Distance (km)
Kopi	Kopi	Domestic, medical, oily debris, contaminated soil, drums, metal	–
Kopi	Gobe	Incinerator ash, tyres, restricted wastes (e.g., batteries)	85
Gobe	Gobe	All waste	–
Mubi River Bridge	Gobe	All waste	42
Kutubu Ridge	Gobe	All waste	83
Moro Camp	Gobe	All waste	94
Homa Camp	Hides	All waste	62
Hides Gas Conditioning Plant	Hides	All waste	15
Hides Ridge Drilling	Hides	Drill cuttings	20
Hides Ridge Drill Camp	Hides	All waste	20
Juha Camp	Hides	All waste	60

Restricted waste will be transported to the Gobe or Hides waste management area. No restricted waste will be transported to Kopi waste management area.

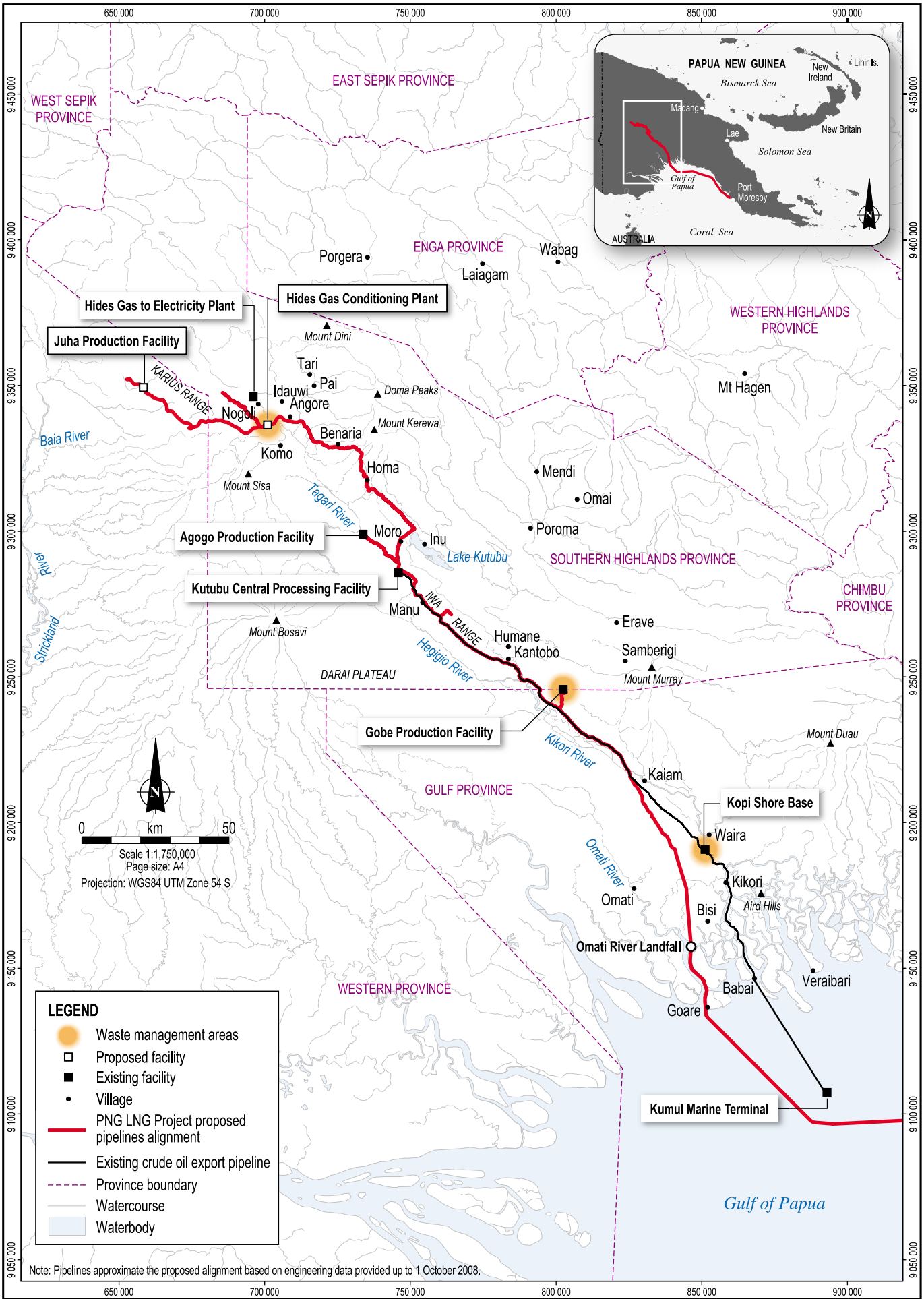
Waste generated at the LNG Facilities site will have less need for transport over long distances, as there will be a waste management area on site.

Wastes generated by vessels associated with offshore pipeline construction will be segregated and delivered to the LNG Facilities waste management area.

25.4.1 Waste Management Area Infrastructure: Upstream

25.4.1.1 Landfill at Hides

The PNG LNG Project requires a landfill at Hides of approximately 250,000 m^3 capacity for the life of the project (i.e., from 2012 to 2043). It will be an engineer-designed, lined landfill including groundwater monitoring capability (Section 25.1.2.7, Monitoring). The landfill will be designed and constructed as part of project early works. The landfill will be capable of accepting ash from the high-temperature incinerator and will be divided into restricted and non-restricted sections. The majority of wastes to be disposed of to landfill are non-restricted materials.



PNG LNG	Date: 19.11.2008 MXD: PNG_LNG_Project_GIS.mxd File Name: 1284_09_F25.01_GIS_HB	Esso Highlands Limited PNG LNG Project	Hides, Gobe and Kopi waste management areas	Figure No: 25.1

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25.4.1.2 Landfill at Gobe

The capacity of the existing lined, engineered landfill at Gobe (operated by Oil Search Limited) will be expanded from 3,500 m^3 to 28,200 m^3 to accommodate the estimated requirements during construction of the PNG LNG Project. Like the Hides facility, the Gobe landfill will be properly designed with divisions for restricted and non-restricted materials and have a groundwater monitoring capability. The landfill will be constructed during project early works. The Gobe landfill will accept waste from the Kopi waste management area, due to a lack of suitable land for a landfill at Kopi. The Gobe landfill will only be utilised during construction, not in operations. Waste generated during operations will be transported to the Hides landfill for disposal.

25.4.1.3 High-temperature Incinerators

The project will require three new high-temperature incinerators, one each at the Kopi and Hides waste management areas for construction and operations waste and a third at the Hides rotator community. These will be newly-installed, high-temperature incinerators with a capacity of approximately 20 m^3/d each. The high-temperature incinerators will be designed and constructed during project early works.

25.4.1.4 Sludge Filter Press

The project will manage sewage sludge disposal by incineration. Sewerage treatment plants will be fitted with sludge dewatering capability to enable this, e.g., a filter press.

25.4.1.5 Tyre Debeader and Industrial Shredder

Tyre disposal by incineration requires debeading and shredding with a large industrial shredder. The shredder can also be used to shred other waste, such as crates, vegetation, white goods and drums.

25.4.1.6 Drum Cleaning and Crushing Facility

To ensure there is available landfill capacity across the project area, there will be a drum cleaning and crushing facility at the Gobe and Hides landfill sites.

25.4.1.7 Waste Management Area Runoff and Collection

Where permanent waste management facilities and hardstand waste management areas are installed, a runoff containment system will be installed and maintained. This will be necessary at the Kopi, Gobe and Hides waste management areas.

25.4.2 Waste Management Area Infrastructure: LNG Facilities

All onsite waste management facilities (including the engineered landfill) will be provided with the following:

- Fences or barriers for separating incompatible or specific types of wastes.
- Designated areas for segregating re-usable or recyclable materials.
- A security fence with a locked access gate.
- An appropriate secondary containment capability for hazardous materials.

25.4.2.1 Landfill

The LNG Facilities site landfill will be an engineer-designed, lined landfill including groundwater monitoring capability as per IFC guidelines (Section 25.1.2.7, Monitoring) and will be operated as a limited-access facility.

The LNG Facilities site landfill will accept waste from the LNG Plant, marine facilities, camps and all associated infrastructure and will be used during both construction and operations.

25.4.2.2 High-temperature Incinerator

The project will install a high-temperature incinerator at the LNG Facilities site for construction and operations waste with a capacity of approximately 20 m^3/d.

25.4.2.3 Sludge Filter Press

The project will manage sewage sludge disposal by incineration. Sewage treatment plants will be fitted with sludge dewatering capability to enable this, e.g., a filter press.

25.4.2.4 Tyre Debeader and Industrial Shredder

Tyre disposal by incineration requires debeading and shredding with a large industrial shredder. The shredder can also be used to shred other waste, such as crates, vegetation, white goods, and drums.

25.4.2.5 Drum Cleaning and Crushing Facility

To ensure there is available landfill capacity across the project area, there will be a drum cleaning and crushing facility at the LNG Facilities landfill site.

25.4.2.6 Waste Management Area Runoff and Collection

Where permanent waste management facilities and hardstand waste management areas are installed a runoff containment system will be installed and maintained. This will be necessary at the LNG Facilities waste management area.