

1. INTRODUCTION

Esso Highlands Limited (Esso), a Papua New Guinea-based subsidiary of the Exxon Mobil Corporation, proposes to develop the Papua New Guinea Liquefied Natural Gas Project (PNG LNG Project) to commercialise gas reserves in the Southern Highlands and Western provinces of Papua New Guinea by processing the gas and then transporting it via pipeline from these provinces through Gulf Province and the Gulf of Papua to LNG producing and exporting facilities in Central Province (Figure 1.1).

Esso (the proponent) has prepared this environmental impact statement (EIS) as the statutory basis for the environmental and social assessment of the project under s. 50 of the *Environment Act 2000*. This assessment will enable a decision from the Environment Council and the Minister on whether the project should proceed and, if so, under what conditions. Coffey Natural Systems Pty Ltd, a subsidiary of Coffey International Pty Ltd, was commissioned to assist Esso in the preparation of this EIS.

The EIS sets out a development proposal to enable an assessment of the environmental and social implications of the project by:

- The co-venturers in their decision to sanction the project to proceed.
- The public in formulating their responses to the EIS.
- The relevant PNG Government agencies in evaluating the project's potential environmental and social impacts and in formulating conditions under which it might proceed.
- Possible financiers of the project.

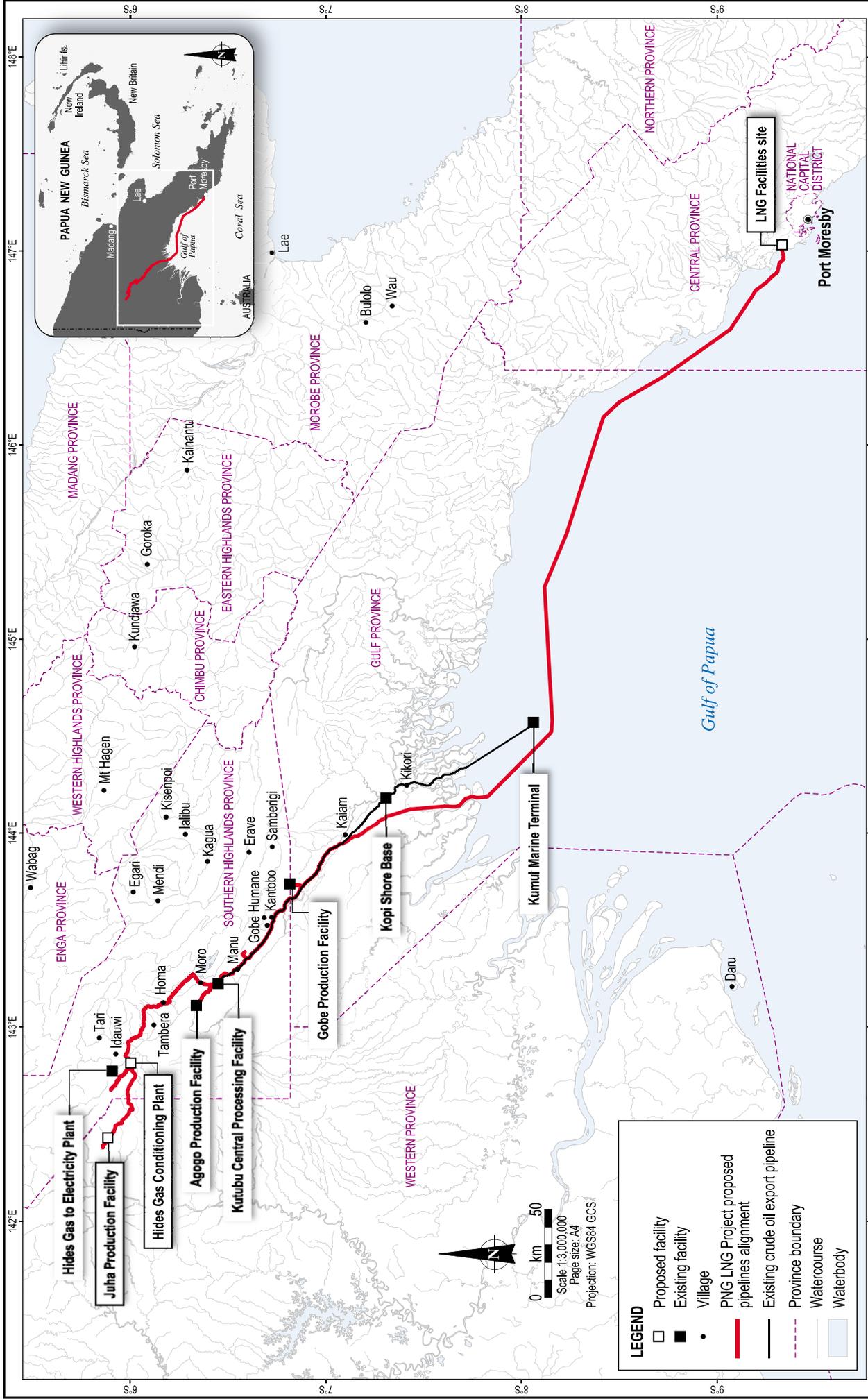
This chapter provides background information on liquefied natural gas, a new industry in Papua New Guinea, and on the developments that led to this proposal (Section 1.1); a high-level overview of the proposed project, including scheduling, current status, objectives, impacts and staffing (Section 1.2); the co-venturers in the project (Section 1.3); and information about the EIS statutory context and structure and how to obtain a copy of the EIS (Section 1.4).

1.1 Background

1.1.1 Liquefied Natural Gas

The PNG LNG Project, if approved, will be the first liquefied natural gas (LNG) development in Papua New Guinea. The development will affect people in four provinces (Western, Southern Highlands, Gulf and Central) who may wonder what LNG is, so a brief explanation and history of LNG is provided here, mostly summarised from Foss et al. (2003) and Foss et al. (2007).

LNG is produced at an LNG plant by cooling natural gas to a very low (cryogenic) temperature until the gas becomes a liquid. The process reduces the volume of the natural gas to 1/600th of its unliquefied volume. This much smaller volume allows large amounts of natural gas to be



Note: Pipelines approximate the proposed alignment based on engineering data provided up to 1 October 2008.

Scale 1:3,000,000
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Projection: WGS84 GCS

0 km 50 km

LEGEND

- Proposed facility
- Existing facility
- Village
- PNG LNG Project proposed pipelines alignment
- Existing crude oil export pipeline
- - - Province boundary
- Watercourse
- Waterbody

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Figure No: 1.1

Localty map of proposed PNG LNG Project facilities and pipelines

transported economically over long distances by special ships called LNG carriers. When the LNG is unloaded at an international port, it is usually transported via pipeline to a nearby regasification terminal, where the LNG is heated and returned to its gaseous state. The resultant natural gas is then distributed to customers via natural gas pipelines and reticulation systems.

Commercial LNG has been produced for over 65 years and transported and used around the world for over 45 years. In 2007, approximately 168 million metric tonnes of LNG were handled by 23 LNG export (liquefaction) terminals, 58 import (regasification) terminals, and 224 LNG carriers. BS Energy (2007) reported that an additional 21 LNG carriers, all but one of which could carry more than 140,000 m³ of LNG, were delivered during 2007.

LNG is non-toxic and non-corrosive and is stored and transported at atmospheric pressure. Since it is not under pressure, storing and transporting pose little danger, as long as the LNG is contained within storage tanks, piping and other equipment (such as LNG carriers) designed for use at LNG cryogenic temperatures.

However, vapours resulting from an uncontrolled release of LNG can be hazardous. Fatal accidents occurred at several onshore facilities in the early years of the industry, the first (and worst) in Cleveland, Ohio, in 1944 when an unbunded LNG storage tank made of the wrong type of steel leaked and the vapours entered the town's stormwater system. Fifty employees and 78 town residents were killed in the resultant explosions and fires. More stringent operational and safety regulations have resulted in a steady improvement in safety, although this has been marred by three fatal accidents in 1977, 1979, and 1983 (which killed a total of five employees) and the January 2004 explosion and fire at the Skikda LNG facility in Algeria (which killed 27 employees). This most recent accident occurred because three safety measures, which are standard in modern LNG plants, had not been fitted at Skikda. None of these facilities was owned or operated by Exxon Mobil Corporation (ExxonMobil)¹.

Foss et al. (2007) noted that '[o]verall, the LNG industry has an excellent safety record compared to refineries and other petrochemical plants'.

The market for LNG is based on the fact that some customers for natural gas are too far from the gas fields for producers to supply the gas by pipeline. In the form of LNG, natural gas can be economically transported by LNG carriers to distant customers. LNG carriers are designed specifically to keep the LNG at the correct cryogenic temperature, and the carriers are double-hulled to prevent ruptures. To date, no fatal accidents have occurred with LNG carriers. As Foss et al. (2007) reported:

LNG has been safely delivered across the ocean for over 40 years. In that time, there have been over 45,000 carrier voyages, covering more than 100 million miles, without major accidents or safety problems either in port or on the high seas (as cited in SIGTTO, undated). The LNG industry has had to meet stringent standards set by countries such as the U.S., Japan, Australia, and the European nations.

According to the U.S. Department of Energy, over the life of the industry, eight marine incidents worldwide have resulted in spillage of LNG, with some hulls damaged due to cold fracture, but no cargo fires have occurred. Seven incidents not involving spillage were recorded, two from groundings,

¹ References to ExxonMobil in this document refer to Esso and the ExxonMobil group of companies.

but with no significant cargo loss; that is, repairs were quickly made and leaks were avoided. There have been no LNG shipboard fatalities.

Modern LNG facilities are designed specifically to prevent spillage and to contain it if spillage does occur. Spillage onto land forms a pool, which evaporates. LNG is not explosive, and a spill can only ignite (if there is an ignition source) at its edges, where the gas/air mixture is in the flammability range of between 5% and 15% gas in air. LNG spilled onto water floats on the surface, spreads laterally, evaporates and dissipates (again, being able to burn only if there is an ignition source and the gas/air mixture is in the flammability range). The safety setbacks and spill containment incorporated into the layout of the PNG LNG Project facilities are designed to protect the public from the heat of a possible LNG spill fire.

Setbacks and containment are discussed in 'LNG Facilities Safety Philosophy' in Section 4.2.1.3, LNG Facilities Layout; and LNG safety is discussed more fully in Attachment 1, LNG Safety.

1.1.2 Prior Petroleum Developments and Proposals

Oil was first discovered in Papua New Guinea in 1911, but it was not until the 1980s that substantial reserves of oil and gas were found in Southern Highlands Province. Gas production began at Hides for the Hides Gas to Electricity Plant in 1991, followed by oil production at Kutubu (Kutubu Petroleum Development Project) the following year. In 1995, Chevron Asiatic Ltd proposed the first gas project in Papua New Guinea (the PNG Gas Project) to build on this established petroleum production infrastructure by commercialising gas from gas or oil fields at Kutubu, Gobe, Agogo and Moran and exporting the gas by pipeline to Australia.

Chevron subjected the PNG Gas Project to a series of feasibility, socio-economic and environmental investigations in the years that followed and investigated the feasibility of scope changes to simplify the project concept, to reduce projected capital cost and to improve the project's economic outlook. However, the project went into abeyance in 2000 and shortly thereafter, Chevron sold its PNG petroleum interests to Oil Search Limited.

By 2004, eastern Australia's tightening natural gas supply and growing gas demand had improved the PNG Gas Project's competitive position, and the project was revived, with Esso (who had interests in the Hides gas field) as the operator. In late 2004, Esso proceeded to front-end engineering design (FEED) and an environmental assessment. During the course of 2005 and 2006, an EIS was prepared and presented to the PNG Government (Enesar, 2005). While an Approval-in-Principle was recommended by the Environment Council on 19 December 2006, significant cost growth and the withdrawal from the project of the pipeline consortium for the Australian portion of the project sent the PNG Gas Project into abeyance once again at the end of January 2007 before EIS approval was received.

The studies conducted by Esso for the PNG Gas Project encouraged licensees of the gas fields at Hides, Angore and Juha to enter into an agreement to evaluate production and export of LNG as an alternative to previous project proposals. This new development proposal, the PNG LNG Project, is the outcome.

1.2 Overview of the Development Proposal

1.2.1 Project Description

The PNG LNG Project will enhance and expand existing production fields and facilities developed in Southern Highlands Province in the 1990s, constructing a portion of the project adjacent to or within the footprint of the existing oil production and transport facilities and infrastructure from Kutubu to Kopi.

Natural gas to be used as feed gas for LNG processing will be produced from gas fields at Hides, Angore and Juha via the Hides Gas Conditioning Plant and the Juha Production Facility and from a gas field at South East Hedinia and the existing oil fields via the existing facilities at Kutubu, Agogo and Gobe. The natural gas will be conditioned and then transported via an onshore pipeline to the Gulf of Papua and then via an offshore pipeline to the onshore LNG Plant some 20 km northwest of Port Moresby at Caution Bay, where it will be liquefied and then exported via LNG carriers to international gas markets. In addition to LNG, the project will produce some condensate at Hides and at the LNG Plant. The former will be transported via pipeline to storage tanks at Kutubu and then exported via the existing crude oil pipeline to the existing Kumul Marine Terminal; the latter will be stored in tanks at the LNG Plant and then exported via condensate carriers.

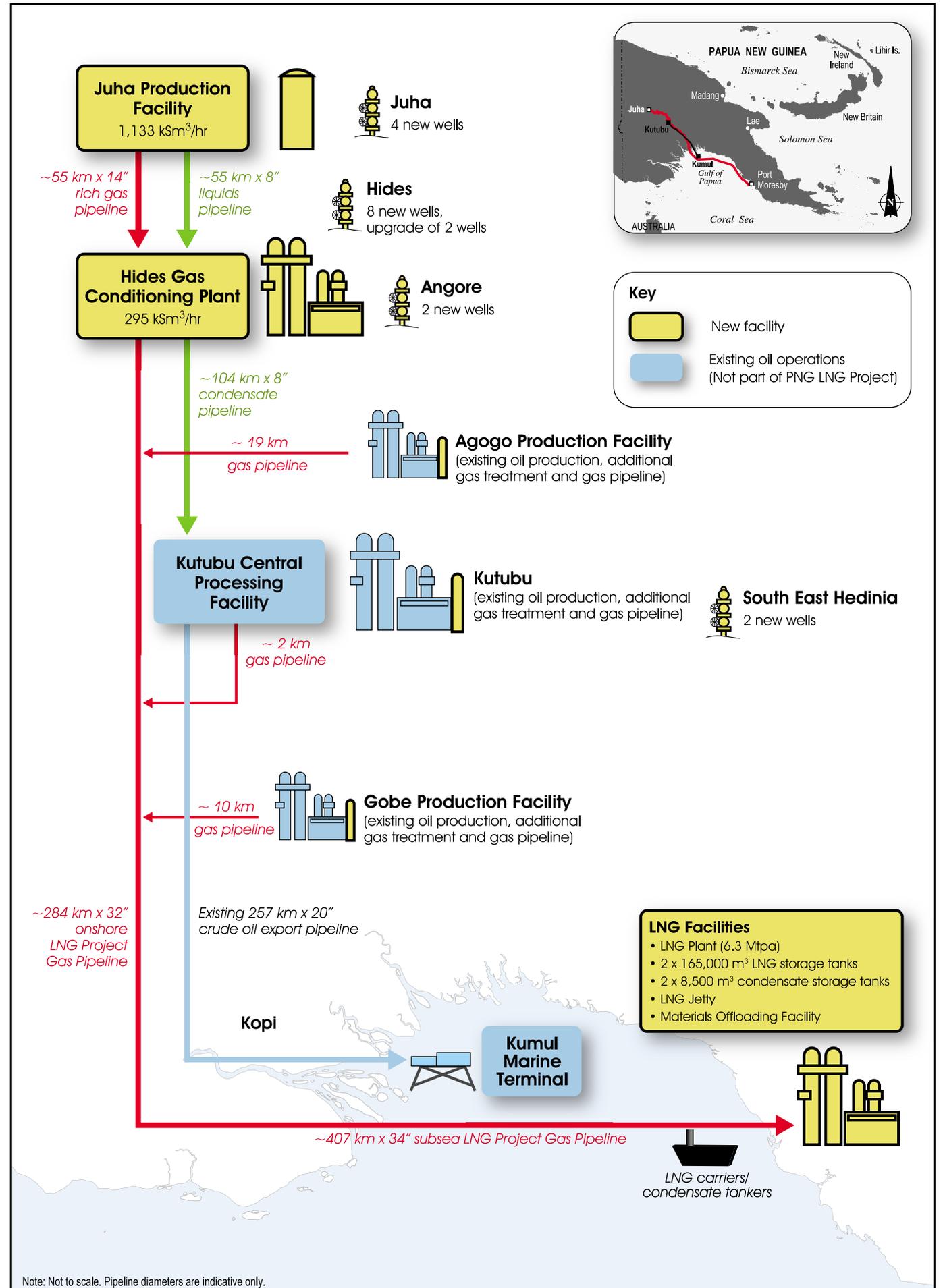
Figure 1.2 shows the new facilities to be constructed as part of the project and the existing facilities that are part of the oil operations.

Because the supply of gas to the LNG Plant must be maintained over a long period (see Section 1.2.2, Project Development Schedule and Project Phases), the project will be developed in five phases. The description of the phases below elaborates on the summary above. Complete details of the new or modified components and how they will be constructed, operated, maintained, and decommissioned are provided in Chapter 2, Producing the Gas; Chapter 3, Transporting the Gas; Chapter 4, Producing and Exporting the LNG; and Chapter 5, Project Logistics. In addition, Chapter 6, Pipeline and Facilities Location Context, and Chapter 7, Project Substantiation (Alternatives Analysis) provide further detail, including the options that were evaluated in the course of arriving at the current development proposal.

1.2.1.1 Phase 1 (Initial Development)

Phase 1 developments include:

- Constructing three wellpads, drilling six wells, and recompleting two existing wells at the Hides gas field.
- Constructing the Hides gathering system to bring the gas from the Hides field to the Hides Gas Conditioning Plant.
- Constructing the Hides Gas Conditioning Plant to separate the gas and condensate and condition the gas for use as feed gas at the LNG Plant.
- Constructing the LNG Facilities, including the onshore LNG Plant and other onshore and marine facilities and infrastructure.
- Constructing the LNG Project Gas Pipeline onshore and offshore sections from Hides to the LNG Plant.



Note: Not to scale. Pipeline diameters are indicative only.

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| | Job No: 1284 | Esso Highlands Limited | Project overview: new and existing facilities and pipeline | Figure No: 1.2 |
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- Constructing the Hides–Kutubu Condensate Pipeline from Hides to the crude oil storage tanks at Kutubu.
- Constructing a scraper station southwest of Kopi.
- Constructing the gas treatment modifications to the Kutubu Central Processing Facility and the Gobe Production Facility.
- Constructing the Kutubu and Gobe gas pipelines to connect the new gas treatment equipment to the LNG Project Gas Pipeline.

1.2.1.2 Phase 2 (Additional Drilling)

Phase 2 involves:

- Constructing one wellpad and drilling an additional two wells at the Hides gas field.
- Constructing two wellpads and drilling two wells at the Angore gas field.
- Constructing the Angore gathering system to bring the gas from the Angore gas field to the Hides Gas Conditioning Plant.

1.2.1.3 Phase 3 (Hides Gas Conditioning Plant Booster Compression)

Phase 3 development involves installing additional booster compression at the Hides Gas Conditioning Plant to maintain gas production volumes.

1.2.1.4 Phase 4 (Juha Gas Field Development)

Phase 4 involves:

- Constructing three wellpads and drilling four wells at the Juha gas field.
- Constructing the Juha gathering system to bring the gas from the Juha gas field to the Juha Production Facility.
- Constructing the Juha Production Facility to separate gas and liquids from the Juha gas field.
- Constructing the Juha–Hides Rich Gas Pipeline and the Juha–Hides Liquids Pipeline to transport rich gas and liquids from the Juha Production Facility to the Hides Gas Conditioning Plant.
- Constructing the Hides–Juha MEG Pipeline to carry mono-ethylene glycol (MEG) from the Hides Gas Conditioning Plant to the Juha Production Facility.

1.2.1.5 Phase 5 (Associated Gas Developments)

Phase 5 involves sourcing gas from the existing Agogo and Moran oil fields and new South East Hedinia gas field:

- The Agogo Production Facility will be modified to treat the gas from the Agogo and Moran fields, and the Agogo Gas Pipeline will be constructed to carry gas from this facility to the LNG Project Gas Pipeline.

- Wells and wellpads will be developed at the South East Hedinia field, a new gathering system will transport the gas to the Kutubu Central Processing Facility, and the Kutubu Gas Pipeline, constructed during Phase 1, will carry gas from this facility to the LNG Project Gas Pipeline.

1.2.2 Project Development Schedule and Project Phases

The indicative project development schedule is shown in Figure 1.3. As discussed in Section 1.2.1, the project will be developed in five phases; and as shown in Figure 1.3, this development will take place over two decades, beginning in mid-2009. Before development can begin, the project must successfully pass several steps, including the decision by the project co-venturers on whether to proceed to development and to seek environmental and petroleum development approvals and licences from the state in 2009 ('project sanction'). This would allow financial arrangements to be finalised ('financial close'), followed by detailed engineering design and construction. The project is expected to have an operational life of approximately 30 years, beginning in late 2013 or early 2014 when the first LNG cargo is expected to be ready for shipment.

Developing the project in phases allows the gas production schedule to be optimised and LNG Plant use to be maximised. The gas schedule in turn guides the order of the development of the main project elements. As reservoir pressures in the gas fields brought on early in the project decline (e.g., Hides, Kutubu, and Gobe), additional wells, gas fields or compression will be developed to maintain the production level, as well as to keep the feed-gas composition within the specifications of the international market to ensure reliability and consistent quality of supply over the project's operational life.

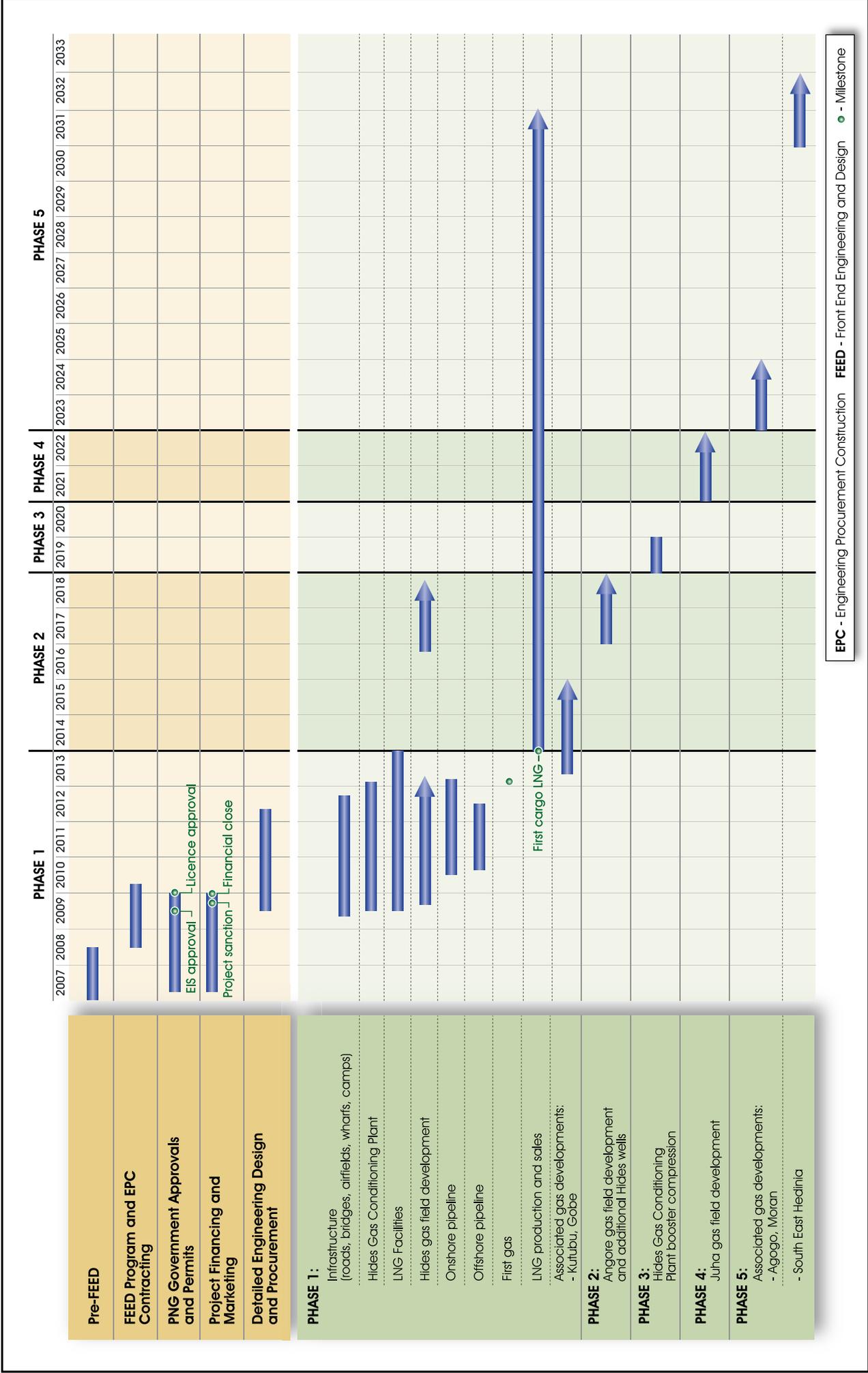
Figure 1.4 shows the planned allocation of gas production from the various fields.

This EIS covers and seeks environmental and planning approvals to proceed to permitting the construction and operation of all five phases of the project.

1.2.3 Current Status of the Project

The development proposal is currently in the front-end engineering and design (FEED) stage (see Figure 1.3), during which the project concept will be developed to achieve an optimum project design. Esso does not expect changes in project design that may occur during the remainder of FEED and during detailed engineering design to materially affect the findings of this EIS, but Esso will assess variations as a matter of course and report any potentially significant change to the relevant government agencies, which will then decide on an appropriate course of action for further assessment and review.

This EIS has sought to address the project's environmental issues to the point where the residual impacts can be understood and where the intent of the proposed mitigation and management measures can be incorporated into the project's detailed design and implementation. Similarly, on the socio-economic side, detailed plans are required to implement those measures within the project's purview (see Section 1.2.5, Project Impacts); and this work is in progress now.




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EPC - Engineering Procurement Construction FEED - Front End Engineering and Design ● - Milestone

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 PNG LNG Project

Indicative project development schedule

Figure No: 1.3

PNG LNG Project

Separator Gas Produced - Annual Average

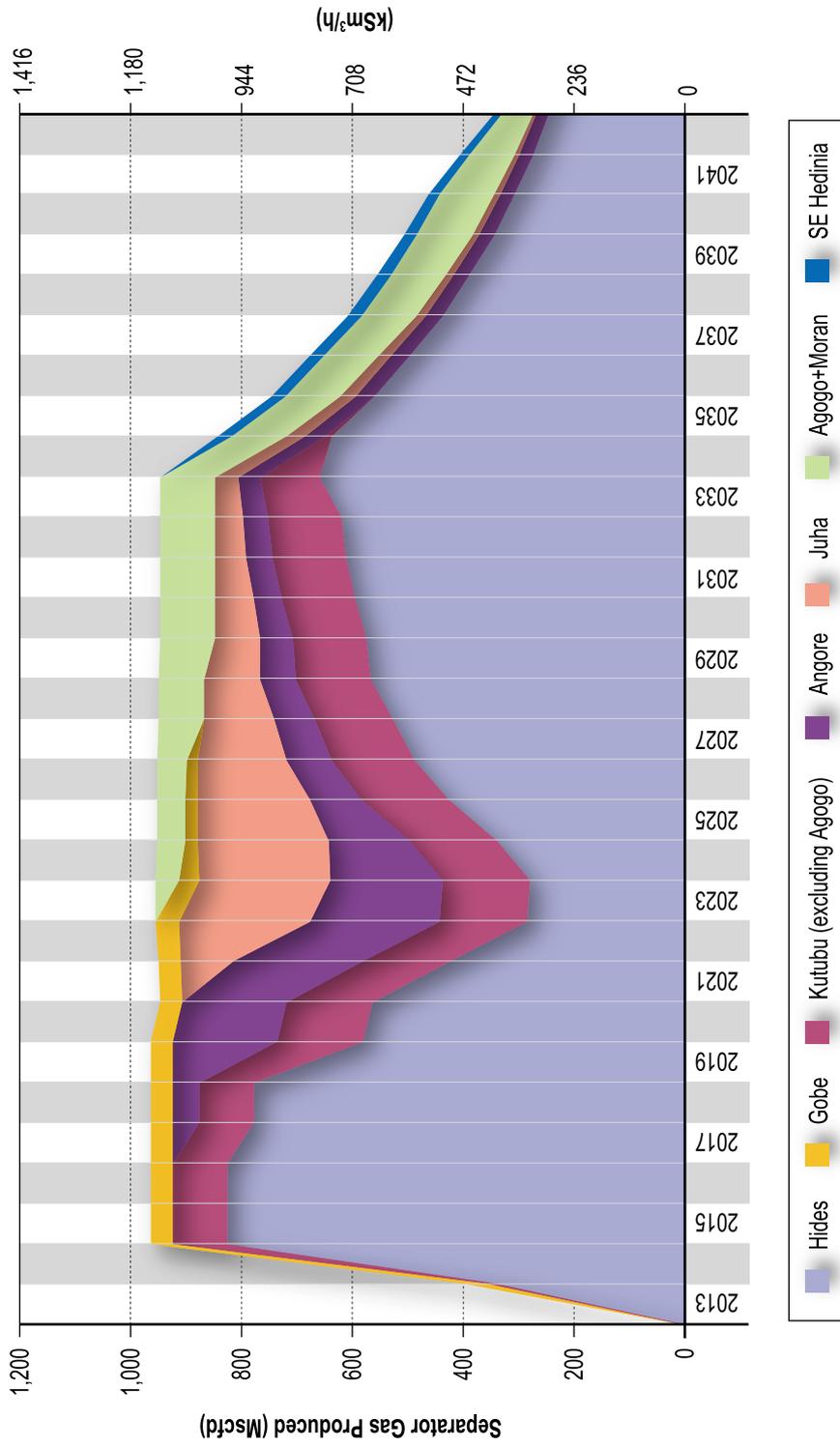


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PNG LNG Project gas supply

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PNG LNG Project

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1.2.4 Project Objectives

Esso is committed to operating the project to meet the environmental and socio-economic performance standards of its organisation (as outlined in Figure 1.5) and to be consistent with the constitutional goals and directives of Papua New Guinea, as stated in the Fourth National Goal and Directive Principle of the Constitution of Papua New Guinea:

We declare our Fourth Goal to be for Papua New Guinea's natural resources and environment to be conserved and used for the collective benefit of us all, and be replenished for the benefit of future generations.

The commercial objective of the project is to develop the gas resources from gas fields at Hides, Angore, Juha and South East Hedinia and from the associated gas produced from the Kutubu, Gobe, Agogo and Moran oil fields.

The social, cultural and economic objective of the project is to deliver the engineering and commercial components of a project that has the potential to benefit local and wider communities at minimal impact on the environment, by:

- Recognising local amenity, values and culture of those people directly affected by the project.
- Managing environmental and social impacts.
- Contributing to the state's economy and human wellbeing.

The environmental objective of the project is to reduce the project's impact on the environment and on affected communities by planning, building and operating the project according to good industry practice, applicable government requirements, realistic community expectations of environmental performance, and international environmental standards.

These objectives are underpinned by the principles and values of the operator and the co-venturers. They are also framed and moderated by the laws and governmental processes of the Independent State of Papua New Guinea in accordance with the customs and priorities of the country.

1.2.5 Project Impacts

The overall scope of the project is sufficiently well defined for the EIS to predict its main environmental impacts, which are as follows:

- The onshore upstream³ elements of the project will break nearly 1,800 ha of new ground, some in the basin of the Kikori River and adjacent subcatchments, which together comprise some 2.3 million ha of almost entirely primary tropical forest. The onshore upstream project area is, even by PNG standards, remote and very little disturbed; but the EIS's predictions of a low biodiversity impact are backed up by the environmental record of the existing oil and gas developments in the same area: the notable biodiversity and conservation assets of the project area have co-existed with oil and gas development for nearly two decades. The onshore

³ Upstream, in this context, refers to all elements of the project that will be sited between Juha gas field and the point where the LNG Project Gas Pipeline enters the LNG Plant at Caution Bay.

ExxonMobil's Environment Policy

It is Exxon Mobil Corporation's policy to conduct its business in a manner that is compatible with the balanced environmental and economic needs of the communities in which it operates. The corporation is committed to continuous efforts to improve environmental performance throughout its operations.

Accordingly the Corporation's policy is to:

- comply with all applicable environmental laws and regulations and apply responsible standards where laws or regulations do not exist;
- encourage concern and respect for the environment, emphasize every employee's responsibility in environmental performance and foster appropriate operating practices and training;
- work with government and industry groups to foster timely development of effective environmental laws and regulations based on sound science and considering risks, costs and benefits, including effects on energy and product supply;
- manage its business with the goal of preventing incidents and of controlling emissions and wastes to below harmful levels; design, operate and maintain facilities to this end;
- respond quickly and effectively to incidents resulting from its operations, in cooperation with industry organizations and authorized government agencies;
- conduct and support research to improve understanding of the impact of its business on the environment, to improve methods of environmental protection and to enhance its capability to make operations and products compatible with the environment;
- communicate with the public on environmental matters and share its experience with others to facilitate improvements in industry performance;
- undertake appropriate reviews and evaluations of its operations to measure progress and to foster compliance with this policy.

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upstream elements of the PNG LNG Project will entail essentially the same activities and, especially, the same limits on public access to project roadways (through terrain that, in any case, has always been unattractive for subsistence life and sparsely settled for that very reason). To these measures, the PNG LNG Project will add a more rigorous program of environmental planning and management than was the case for the first petroleum developments in the early 1990s, thus giving confidence that this renewed phase of petroleum development will have similar effects.

- Many parts of the upstream project area will need to be built in difficult terrain, with steep slopes, unstable soils and heavy rain, but this EIS predicts that the impacts on water courses will be minimal after a period of about one year. The confidence in this prediction reflects the fact that this is what has occurred previously.
- Offshore, the LNG Project Gas Pipeline will be installed over the muddy sediments of the Gulf of Papua to a landfall in Caution Bay – a localised and short-lived disturbance to what is essentially a depositional marine environment – followed by decades of passive operation on the seabed.
- The LNG Facilities site at Caution Bay presents none of the notable biodiversity assets of the upstream project area. It has been largely cleared for agriculture and is, in the regional conservation context, unremarkable. However, the importance to local people of its marine resources is nonetheless high. This represents a land use conflict for the project with the local people make routine and important use of the mangroves and lagoon, but there is, for reasons of safety and security, no alternative but to establish an exclusion zone around the LNG Facilities site, the LNG Jetty and the berths.
- The upstream and LNG Plant processing facilities will handle flammable materials at high pressures and temperatures; and the full complement of industry experience, design standards, verification checks and operating procedures will be deployed to the task of reliable and safe operation through the life of the project. Construction, process and domestic wastes and their associated recovery, treatment and disposal requirements can all be managed within the ambit of standard industry practice.

These natural environmental impact predictions depend on the project being properly implemented. This depends in part on adherence to good industry practice and in part on the conversion of in-principle plans, designs and management commitments set out in this EIS into practice on the ground. Environmental management plans, in particular, are integral to project construction and operations. This EIS takes the first step, which is to identify impact issues and the corresponding planning, design and management commitments and to set out a process, by which these commitments become embedded in the project's execution program. However, this process can only advance in lockstep with construction planning, of which it is an integral part.

On the socio-economic side, the project will have a major, enduring and eagerly awaited positive impact at all levels of PNG society. The major socio-economic impacts will be:

- The project will require a direct capital investment of some K36 billion, is projected to double PNG's gross domestic product to an average of K18.2 billion annually, and will have average recurrent project expenditure of up to K680 million per year (ACIL Tasman, 2008). Over the 30-year operational life of the project, gross taxation revenue to the national government is projected to total K67 billion, and royalty payments are estimated to amount to K5.3 billion and are expected to accrue approximately one-third to provincial governments and approximately

one-tenth to local-level governments, with the balance (amounting to more than half the total) going to landowners (Appendix 26, Social Impact Assessment).

- In addition, the project creates the potential for new industrial development in Papua New Guinea, which could bring substantial positive revenue and employment effects. These benefits can be expected to be maintained for the 30-year project operational life (see Chapter 7, Project Substantiation (Alternatives Analysis)).
- As far as the customary landowners within the project area are concerned, they have consistently expressed their support for gas development in a series of attitude and opinion surveys conducted in 1997, 2004, 2005 and 2008 (see Section 23.1, Introduction, and Appendix 26, Social Impact Assessment). The foundation of this support lies in the project's potential to maintain and extend existing benefits and promote socio-economic development.

Unlike the impacts on the natural environment, the socio-economic benefits of Papua New Guinea's existing petroleum projects have fallen short of ideal. Much of the wealth that has accrued to all levels of government and to project landowners has been spent on consumption rather than infrastructure and services. This presents a dilemma, because it has been Papua New Guinean systems of governance, social organisation and distribution and exchange—properly based as they are on the principles of democracy and grass roots empowerment—that have been wholly in control of this expenditure.

The main difference between the PNG LNG Project and its predecessors is in the scale and longevity of its macroeconomic impact. The project will double the country's gross domestic product. How the opportunities and hazards of this bounty are handled will rest with the workings of the democratic, political system of the Independent State of Papua New Guinea.

However, it is within the project's remit to fulfil its socio-economic obligations under PNG law and Esso policy: training and localisation, business development, local employment, PNG content in goods and services purchased, and compensation of landowners for project land requirements. It is also for the project to manage its construction logistics, which will provide substantial business to Papua New Guinea's two main ports of Port Moresby and Lae. The project will also manage the social infrastructure and social impact of construction, which will see large workforces (see Section 1.2.6, Project Staffing) living at the LNG Facilities site, along the pipeline ROWs, and in the vicinity of the Hides Gas Conditioning Plant.

1.2.6 Project Staffing

Estimated peak full-time equivalent (FTE) positions required for Phase 1 construction and the estimated date at which the peak will occur are shown in Table 1.1 by construction contract. Many of the construction positions involve working a rotating shift, and construction positions will be filled on an as-needed basis (in other words, not necessarily for an entire year). Thus, the estimate has been calculated in terms of the peak full-time equivalent positions that will be required. This means that the actual number of people employed during construction will be different from the number of full-time equivalent positions shown in Table 1.1. For example, positions that require people to work a rotating shift of, say, 28 days on/28 days off will require two people to carry out each position, while positions that require people to work a non-rotating shift of, say, five days on/two days off require only one person to carry out each position.

Table 1.1 Estimated number of peak full-time equivalent positions required for Phase 1 construction

| Construction Contract | Peak FTEs* | Date of Peak |
|--|------------|--------------|
| Early works (such as roads and bridges to open logistics routes) | 950 | May 2010 |
| Offshore pipeline (including shore-based landfall construction) | 600 | April 2011 |
| LNG Facilities | 7,500 | July 2012 |
| Hides Gas Conditioning Plant (including wellpad construction) | 1,000 | March 2012 |
| Onshore pipelines (including access ways) | 3,900 | January 2012 |
| Drilling at Hides gas field during Phase 1 | 200 | July 2012 |

* Full-time equivalent (FTE) is a way to measure a worker's involvement in a project. An FTE of 1 means that the person is equivalent to a full-time worker, while an FTE of 0.5 signals that the worker is only half-time. For example, if the work year is defined as 2,080 hours, then one worker occupying a full-time job all year would represent 1 FTE. Two employees working for 1,040 hours each would represent 0.5 FTE each, or 1 FTE between the two of them.

Recognising that the work force for the various contracts peak at different times, the composite peak FTE positions for all contracts combined is estimated to be 12,500 FTEs in April 2012.

Operations employment is more straightforward, as it involves long-term, permanent positions at specific operational locations, as shown in Table 1.2.

Table 1.2 Estimated number of employees required for operations

| Employment Location | Esso | Normal Contractors | Total Esso + Normal Contractors | Turnaround Contractors* |
|--|------|--------------------|---------------------------------|-------------------------|
| Port Moresby project management office | 170 | 110 | 280 | n.a. |
| LNG Facilities | 240 | 360 | 600 | 300 |
| Hides Gas Conditioning Plant | 180 | 320 | 500 | n.a. |
| Total | 590 | 790 | 1,380 | 300 |

*Contractors hired to perform major maintenance, or turnaround, work typically involving two to three months of employment. Turnarounds will occur periodically but infrequently during the 30-year operational life of the project.

1.3 PNG LNG Project Co-Venturers

1.3.1 Co-venturers of the PNG LNG Project

Esso (the proponent) will be the operator of the project. The project is to be achieved through a co-venture between Esso, Oil Search Limited (OSL), Santos Ltd, AGL Energy Limited, Nippon Oil Exploration Limited and the Independent State of Papua New Guinea (the state) and landowners (Table 1.3).

The co-venturers of the PNG LNG Project hold equity directly or indirectly in some or all of the associated gas and oil fields.

Table 1.3 Co-venturers of the PNG LNG Project and their interest in the PNG LNG Project

| Co-venturer | Interest in the PNG LNG Project |
|--|---------------------------------|
| Exxon Mobil Corporation (Esso Highlands Limited as operator) | 32.9% |
| Oil Search Limited | 28.7% |
| Santos Ltd | 13.7% |
| AGL Energy Limited* | 3.6% |
| Nippon Oil Exploration Limited | 1.7% |
| PNG state and landowners** | 19.4% |

*AGL announced on 30 October 2008 that it had executed sale and purchase agreements with an undisclosed international oil and gas company for all its oil and gas exploration and production interests in Papua New Guinea, including its 3.6% interest in the PNG LNG Project.

**The PNG state and landowners consist of the Mineral Resources Development Company (MRDC) with a 2.78% interest in the project, Eda Oil Limited (0.24% interest), and a wholly owned subsidiary of Independent Public Business Corporation of Papua New Guinea (16.39% interest).

The project involves the respective resources of the co-venturers in a number of petroleum development licence (PDL) and petroleum retention licence (PRL) areas, which are described in Section 8.2.6, Summary of Project Approvals.

1.3.2 Company Profiles

1.3.2.1 Esso Highlands Limited

Esso is the project proponent and is the operator of the PNG LNG Project. The company is a wholly owned subsidiary of Exxon Mobil Corporation, the world's largest energy-related publicly traded company. ExxonMobil businesses operate in almost 200 countries and territories, principally in:

- Oil and gas exploration and production.
- Refining, supplying and marketing petroleum products.
- Manufacturing and marketing petrochemicals.

The ExxonMobil group of companies is the largest non-government marketer of equity (own production) natural gas and crude oil in the world. It markets more than 11 billion cubic feet per day of natural gas in 28 countries.

ExxonMobil is a pioneer and leader in LNG. It is one of the longest serving participants in the global LNG industry, with more than 30 years of experience in developing and commercialising LNG in Qatar and Indonesia. ExxonMobil's LNG experience extends throughout the LNG value chain from upstream production, liquefaction and marine transportation to onshore and offshore regasification and direct marketing of LNG.

1.3.2.2 Oil Search Limited

Oil Search is a public company incorporated in Papua New Guinea in 1929. The company has explored for petroleum in Papua New Guinea since then and became a producer of gas and then oil with the commissioning of production facilities respectively at Hides (1991) and Kutubu (1992). In 1998, Oil Search acquired the PNG oil and gas interests of BP Petroleum Development

Limited, including gas production to supply the Hides Gas to Electricity Plant. In 2002, Oil Search acquired the interests of Chevron Niugini Limited and the operations of the Kutubu, Gobe and Moran petroleum development projects. In 2006, Oil Search developed the oil reserves of the South East Mananda field. Oil Search also operates the Kutubu crude oil export pipeline and the Kumul Marine Terminal.

In 2003, Oil Search merged with the PNG resource company, Orogen Minerals Limited.

Oil Search is Papua New Guinea's most active oil and gas explorer, holding the most extensive acreage position and the largest reserves of both oil and gas. The company is also Papua New Guinea's largest oil and gas producer and was responsible for generating 11% of the country's gross domestic product and 21% of its export revenue in 2007.

1.3.2.3 Santos Ltd

Santos Ltd is a major Australian oil and gas exploration and production company with interests and operations in every major Australian petroleum province, as well as in Papua New Guinea and numerous other countries. The company is Australia's largest domestic gas producer and, in 2007, produced 59.1 million barrels of oil. It has a current market capitalisation of approximately A\$8 billion (Santos, 2008). Santos is a proven operator of onshore and offshore oil and gas projects, both in Australia and overseas. The company has experience with LNG via its equity in the Darwin LNG Project, which provides Australian LNG to Japan. Santos is proposing to develop a major LNG plant at Gladstone, Queensland, in a joint venture with PETRONAS, one of the largest LNG producers in the world. The company commenced oil and gas exploration and production in Papua New Guinea in the late 1980s.

1.3.2.4 AGL Energy Limited

AGL Energy Limited is Australia's largest, integrated renewable energy company and has a diverse portfolio of Australian and international assets. It is a publicly listed company with a market capitalisation of approximately A\$5 billion (AGL Energy Limited, 2008). To 2008, AGL held equity gas interests in Papua New Guinea at the Kutubu oil field (11.9%) and the Gobe oil field (66.7%). In May 2008, AGL announced the decision to sell its oil and gas project and licence interests in Papua New Guinea; and in October 2008, AGL announced that it had executed sale and purchase agreements with an undisclosed international oil and gas company for these interests, including its 3.6% interest in the PNG LNG Project. The identity of the purchaser of AGL's share in the PNG LNG Project remained confidential at the time of writing this EIS.

1.3.2.5 Nippon Oil Exploration Limited

Nippon Oil Exploration Limited, a 100% subsidiary of Nippon Oil Corporation, is exploring for and developing and producing oil and gas, with activities in Canada, the Gulf of Mexico, the North Sea, North Africa, Australia, Papua New Guinea and Southeast Asia. It is Japan's largest integrated oil company and is a major oil importer and distributor of petroleum products, holding a 23% share of the Japanese gasoline (petrol) market. Nippon Oil is actively expanding its business into integrated operations that capture value across the whole chain of the natural gas business from exploration to marketing. Currently, Nippon Oil is participating in the Malaysia LNG Tiga Project and the Indonesian Tangguh LNG Project, both of which encompass the full value chain from exploration and development to liquefaction and marketing. The PNG LNG Project is a

strategically important project to Nippon Oil, being its third LNG project, which will ensure a stable supply of energy resources to the company.

1.3.2.6 Mineral Resources Development Corporation Limited

Mineral Resources Development Corporation Limited (MRDC) is a state-owned company incorporated to hold and manage landowner equity interests in petroleum and mining projects. MRDC holds equity in the Kutubu Petroleum Development Project through its subsidiary, Petroleum Resources Kutubu Limited; in the Gobe Petroleum Development Project through Petroleum Resources Gobe Limited; and in the Moran Petroleum Development Project through Petroleum Resources Moran Limited. Other PNG resource projects in which MRDC holds an interest include the Lihir gold mine on Lihir Island, the OK Tedi gold mine and the Ramu nickel joint venture.

MRDC is wholly owned by the PNG Government; and these subsidiary companies are, in effect, the trustees of trusts under which landowners and provincial governments hold interests in PNG oil, gas and mineral developments.

1.3.2.7 Eda Oil Limited

Eda Oil Limited is 100% owned by Petromin PNG Holdings Limited, an entity directly owned by the PNG Government to hold its interests in petroleum and mining resource projects. Eda Oil owns a 0.2% interest in the project derived from its 20.5% interest in the Moran Petroleum Development Project. The Moran project has an asset value of more than K270 million and will supply associated gas to the project (Petromin PNG Holdings, 2007).

Petromin, which was established in 2007, also owns 100% of the Papua New Guinea Tolukuma gold mine. It is Petromin's vision to expand its asset portfolio over time in the resource sector.

1.3.2.8 Independent Public Business Corporation of Papua New Guinea

The nominee for the State of Papua New Guinea will be a wholly owned subsidiary of the Independent Public Business Corporation of Papua New Guinea (IPBC). IPBC is a statutory corporation established by the *Independent Public Business Corporation of Papua New Guinea Act 2002* (the IPBC Act).

Under the IPBC Act, the objects of IPBC are to act as trustee of the General Business Trust (a statutory trust that is also established by the IPBC Act) and hold assets and liabilities that have been vested in or acquired by it, on behalf of the State. IPBC is also to act as a financial institution for the benefit of and the provision of financial resources and services to state-owned enterprises and the State, where this is approved by the National Executive Council.

The State is the sole beneficiary of the General Business Trust. Under the IPBC Act, the purposes of the General Business Trust include to hold assets and liabilities which have been acquired or assumed by or vested in IPBC and to hold the interest of IPBC in ownership or development of assets in conjunction with private-sector investors.

IPBC currently holds 100% ownership of Telikom PNG (telecommunications utility, involved in fixed-line and mobile telephony and wholesale and retail data services), PNG Power (electricity utility, involved in generation, transmission, distribution and retail sale of electricity), Air Niugini (airline and the national flag carrier), PNG Ports (operation of ports) and Eda Ranu (water utility).

Telikom PNG currently enjoys a statutory monopoly in activities and areas in which it operates, except in mobile telephony, which was recently opened to competition. PNG Power also currently enjoys a statutory monopoly in activities and areas in which it operates. Both of these statutory monopolies are limited in time and may be abolished by a change in government policy.

IPBC also holds the State's shareholding in Oil Search Limited.

1.4 This EIS

1.4.1 EIS Statutory Context

This document constitutes an EIS under s. 53 of the *Environment Act 2000* and under the direction of the Department of Environment and Conservation's (DEC's) Section 50 Notice to Undertake an Environment Impact Assessment, dated 31 May 2007.

Under the Environment Act, preparation of an environment impact assessment is a two-step process:

- Submission of an environmental inception report (EIR).
- Submission of an EIS.

Esso submitted the PNG LNG Project Environmental Inception Report in October 2007 (Esso, 2007), with the objectives to:

- Identify the potential environmental and social issues of developing the project.
- Set out the scope of the EIS studies program to address the issues.
- Initiate the process of stakeholder consultation.
- Enable the DEC to review the proposed EIS scope and identify any shortcomings.

On 23 November 2007, the EIR was approved by the DEC, and Esso was directed to conduct an environmental impact assessment and submit an EIS. Under the direction of the DEC, the EIS has been prepared with reference to the DEC's Information Guideline (GL-Env/02/2004) for Conduct of Environmental Impact Assessment and Preparation of Environmental Impact Statement, which formed part of the Section 50 Notice, and the assessment procedures of the Environment Act.

Attachment 2, Cross-reference of DEC Guidelines and Requirements to EIS Sections, is a cross-reference guide between the relevant sections of the EIS and the DEC EIS Guideline, as well as specific environmental and social issues identified by the DEC in their approval of the EIR and various issues raised by the DEC in meetings held during the EIS studies and reporting process.

The purpose of this EIS is to seek approval to construct and commission the PNG LNG Project (with Esso as the operator). Additional information about statutory requirements for the project is provided in Chapter 8, Legal, Administrative and Planning Framework.

1.4.2 EIS Report Structure

The EIS consists of three parts in nine volumes:

- The EIS Executive Summary (Volume 1), which provides an overview of the project impact assessment process and stakeholder consultation for non-technical readers. This summary is available in English, Tok Pisin and Motu.
- The EIS Main Report (this report; Volumes 2 and 3), which is intended to be understood without reference to the specialist studies on which it is based. This report documents the potential biophysical and socio-cultural impacts of the project and describes the project's proposed mitigation and management measures and residual impacts (as well as the benefits to be derived from the project) and the stakeholder consultation program.
- A series of specialist studies (Volumes 4 to 9), which are included as appendices to the EIS. Twenty-six specialist studies were conducted to assess the potential impacts of the project. In addition, as the upstream project area corresponds with a large portion of the previously proposed PNG Gas Project, specialist studies conducted for that project have been either included as appendices to the EIS or have been referenced where appropriate.

The EIS does not disclose information that is confidential for cultural or commercial reasons; however, the operator may provide the former in confidence to the DEC upon request.

The main report is divided into the following parts:

- **Part I – The Project:** Information on the history of the project, its participants, its substantiation, and the guiding legislation; the proposed project elements and the related construction, operations and decommissioning activities; and stakeholder consultation.
- **Part II – Existing Environment:** Information on the characteristics of the existing environmental and social conditions of the onshore and marine environments potentially impacted by the project.
- **Part III – Environmental and Social Impact Assessment and Management:** Assessment of potential impacts, means of mitigation and management, and predicted residual impacts, as well as discussion of cumulative and associated impacts, project waste management, greenhouse gases, and a hazard and risk consequence assessment. Summary of proposed mitigation and management measures, description of environmental management plans, and ongoing environmental monitoring and reporting.
- **Part IV – Reference:** The glossary (which defines technical terms and abbreviations used in the EIS), the bibliography and the study team chapters, as well as the attachments to the EIS.

A table of contents for Volumes 2 to 9, including lists of figures, tables, plates, attachments and appendices, can be found at the beginning of each volume of the main report.

Figure 1.6 provides a guide to the chapters and attachments of the EIS and lists the appendices upon which the main report is based.

EIS for the PNG LNG Project

Executive Summary

Main Report

- PART I
The Project**
1. Introduction
 2. Producing the Gas
 3. Transporting the Gas
 4. Producing and Exporting the LNG
 5. Project Logistics
 6. Pipeline and Facilities Location Context
 7. Project Substantiation (Alternatives Analysis)
 8. Legal, Administrative and Planning Framework
 9. Stakeholder Engagement

- PART II
Existing Environment**
10. Receiving Onshore Environment: Upstream Facilities and Onshore Pipelines
 11. Receiving Marine Environment: Offshore Pipeline
 12. Receiving Onshore Environment: LNG Facilities
 13. Receiving Marine Environment: Marine Facilities
 14. Cultural Heritage Environment: Upstream Facilities and Pipelines
 15. Socio-economic Environment: Upstream Facilities and Pipelines
 16. Cultural Heritage Environment: LNG and Marine Facilities
 17. Socio-economic Environment: LNG Facilities

- PART III
Environmental and Social Impact Assessment and Management**
18. Environmental Impacts and Mitigation Measures: Upstream Facilities and Onshore Pipelines
 19. Environmental Impacts and Mitigation Measures: Offshore Pipeline
 20. Environmental Impacts and Mitigation Measures: LNG Facilities
 21. Environmental Impacts and Mitigation Measures: Marine Facilities
 22. Project-wide Cultural Heritage Impacts and Mitigation Measures
 23. Project-wide Socio-economic Impacts and Mitigation Measures
 24. Cumulative and Associated Impacts
 25. Waste Management
 26. Greenhouse Gases and Climate Change
 27. Environmental Hazard Assessment
 28. Environmental Impact Summary Table
 29. Summary of Mitigation and Management Commitments
 30. Environmental Management, Monitoring and Reporting

- PART IV
Reference**
31. Glossary
 32. Bibliography
 32. Study Team
- Attachments**
1. LNG Safety
 2. Cross-reference of DEC Guidelines and Requirements to EIS Sections
 3. Technical Codes and Standards
 4. Potentially Applicable Legislation
 5. Hazard Identification Summary
 6. ExxonMobil Operations Integrity Management System

Appendices

- Upstream and Offshore Pipeline**
1. Biodiversity Impact Assessment
 2. Aquatic Fauna Impact Assessment
 3. Resource Use Survey of the Omari-Kikori Delta
 4. Hydrology and Sediment Transport Impact Assessment
 5. Water and Sediment Quality Impact Assessment
 6. Groundwater Impact Assessment
 7. Forestry Impact Assessment
 8. Soils and Rehabilitation Impact Assessment
 9. Air Quality Impact Assessment
 10. Noise Impact Assessment
 11. Offshore Impact Assessment
- LNG and Marine Facilities**
12. Biodiversity Impact Assessment
 13. Aquatic Fauna Impact Assessment
 14. Hydrology and Sediment Transport Impact Assessment
 15. Water and Sediment Quality Baseline Impact Assessment
 16. Groundwater Impact Assessment
 17. Soils and Rehabilitation Impact Assessment
 18. Air Quality Impact Assessment
 19. Noise Impact Assessment
 20. Visual Impact Assessment
 21. Road User Survey
 22. Hydrodynamic Modelling
 23. Nearshore Marine Impact Assessment
 24. Resource Use Survey of Caution Bay

- Project-wide**
25. Greenhouse Gas Impact Assessment
 26. Social Impact Assessment (including cultural heritage)



Job No:
1284

File Name:
1284_09_F01.06_HB

Esso Highlands Limited
PNG LNG Project

Figure No:

Guide to the EIS

1.6

1.4.3 Obtaining a Copy of the EIS

Electronic copies of the EIS are available on the PNG LNG website at www.pnglng.com, and electronic or paper copies can be requested from:

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