

PNG Gas Project

Environmental Impact Statement

December 2005



Executive Summary

ExxonMobil



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PNG Gas Project

**Environmental Impact Statement
Executive Summary**



December 2005
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Environmental Impact Statement

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Executive Summary

1. Introduction

1.1 Proponent

The PNG Gas Project is being developed through a joint venture between Esso Highlands Limited and its affiliates (as Operator) and Esso's co-venturers Oil Search Limited and its affiliates, Nippon Oil Exploration Limited through its subsidiary Merlin Petroleum Company Limited, and subsidiaries of Mineral Resources Development Company Limited.

1.2 Objectives

The PNG Gas Project has two interdependent objectives:

- To commercialise the gas reserves of the existing Kutubu, Gobe and Moran oil fields and of the Hides gas field and, in so doing,
- To maximise oil recovery from existing oil and gas fields and facilities.

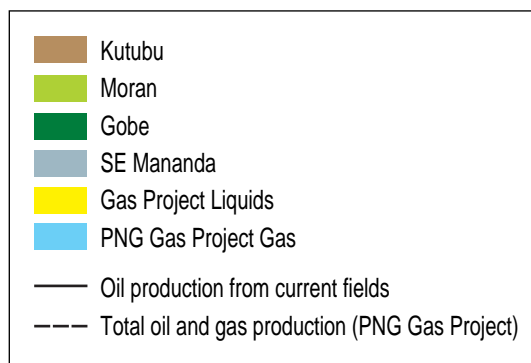
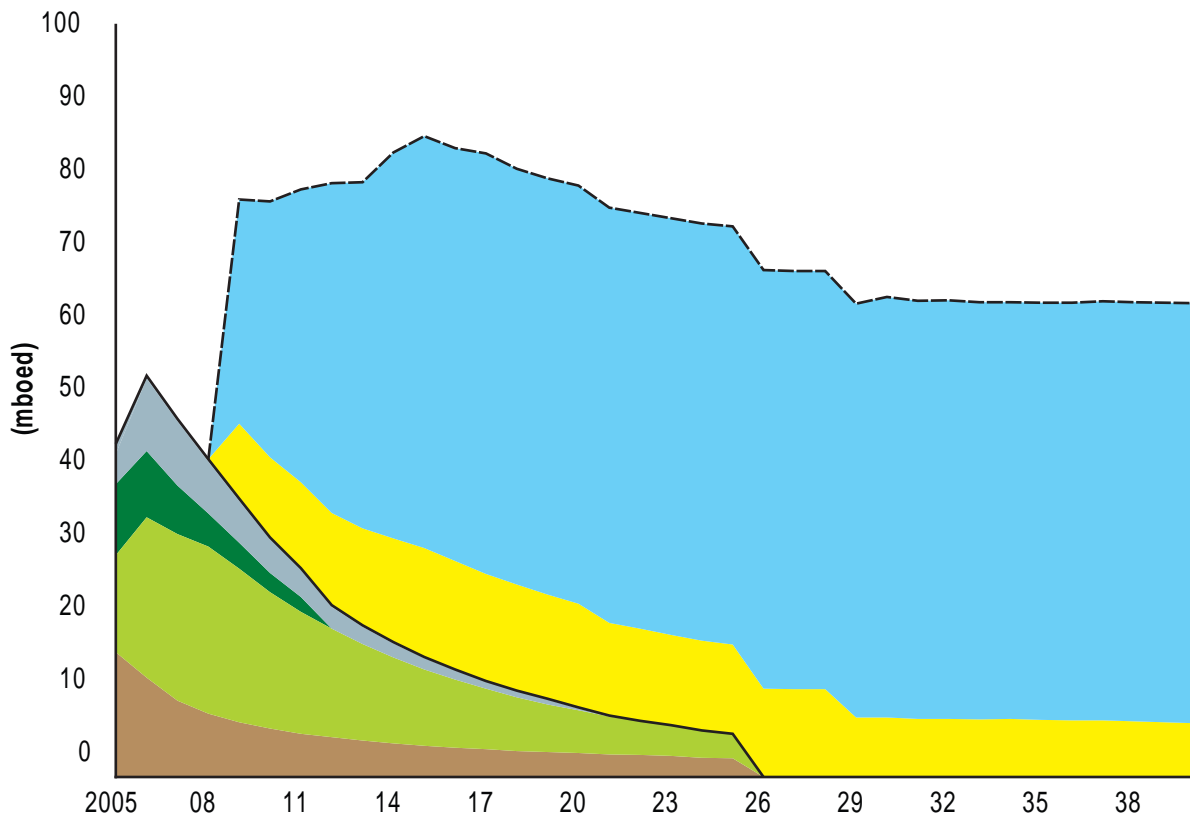
Figure ES1 shows the comparative size of the gas resource associated with the PNG Gas Project compared to the oil resource in question and how the PNG Gas Project might meet these two objectives.

The attainment of these objectives fulfils the resource development policy and revenue goals of the State and provincial governments. For local landowners, the PNG Gas Project will significantly prolong the benefits they currently realise from the country's oil and gas industry.

1.3 Project Overview


The PNG Gas Project will be developed mainly within or adjacent to the footprint of existing oil and gas production facilities (i.e., it is predominantly a 'brownfield' venture). New development in 'greenfield' areas mainly comprises field production facilities at Hides, some 125 km to the northwest of the existing Kutubu Central Production Facility, and new onshore and offshore pipelines. The main project elements are as follows (Figure ES2):

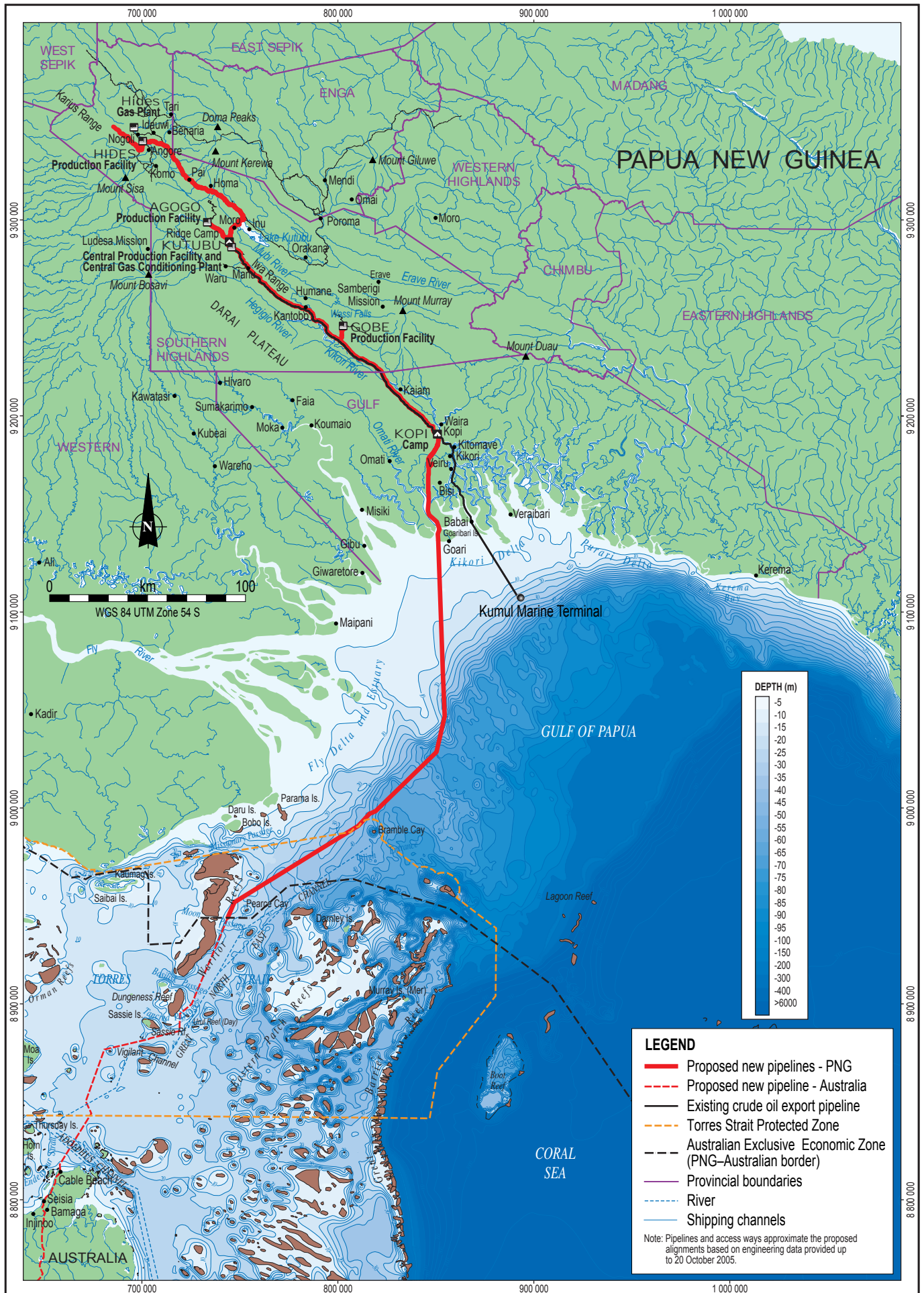
- Wells, gathering system and gas processing facilities at Hides and pipelines to Kutubu.
- A new Central Gas Conditioning Plant to be located near the existing Kutubu Central Production Facility.
- A sales gas pipeline running through the Kikori River basin to the Omati River landfall, and from there offshore across the Gulf of Papua to the international border with Australia. For the majority of its length within PNG, the sales gas pipeline right-of-way (RoW) lies within or adjacent to the easement of the existing crude oil export pipeline.



Note:

Illustrative only showing the significance of the gas commercialisation opportunity provided by the PNG Gas Project relative to continuing oil production. Not intended as an accurate representation of forecast oil and gas production and timing

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|  | Job No: 790 | PNG Gas Project | Nominal oil and gas production profiles with and without the PNG Gas Project | Figure No: ES1 |
| | File No: 790_20_FES1_HB | Esso Highlands Limited | | |



At the international border, the sales gas pipeline owner becomes the AGL Petronas Consortium (APC), who will build the continuation of the pipeline to markets in Australia. Figure ES3 shows the overall scope of the development in Papua New Guinea and Australia.

1.4 Investment, Revenues, Employment and Project Life

The PNG Gas Project's capital investment in Papua New Guinea will be on the order of K8.3 billion (US\$2.5 billion in 2005 dollars), with approximately the same again estimated for recurrent expenditures over the nominal project life of approximately 30 years. Gas production is scheduled to commence in 2009. The estimated net present value of the project to Papua New Guinea is between US\$3 billion and \$US4 billion. Net cash flow to governments and landowners is projected to be US\$3.2 billion over the nominal project life. Construction direct employment¹ will peak at 2,500 positions (the majority of whom will be PNG citizens), and the combined oil and gas operations will directly employ approximately 400 full-time equivalent positions¹.

1.5 The Environmental Impact Statement

The Operator has prepared an Environmental Impact Statement (EIS) in accordance with Section 53 of the *Environment Act 2000*. The EIS seeks approval to construct and commission the PNG Gas Project. Existing operations that will provide gas to the project would continue under their respective licences, approvals and permits.

1.6 Gas Agreement

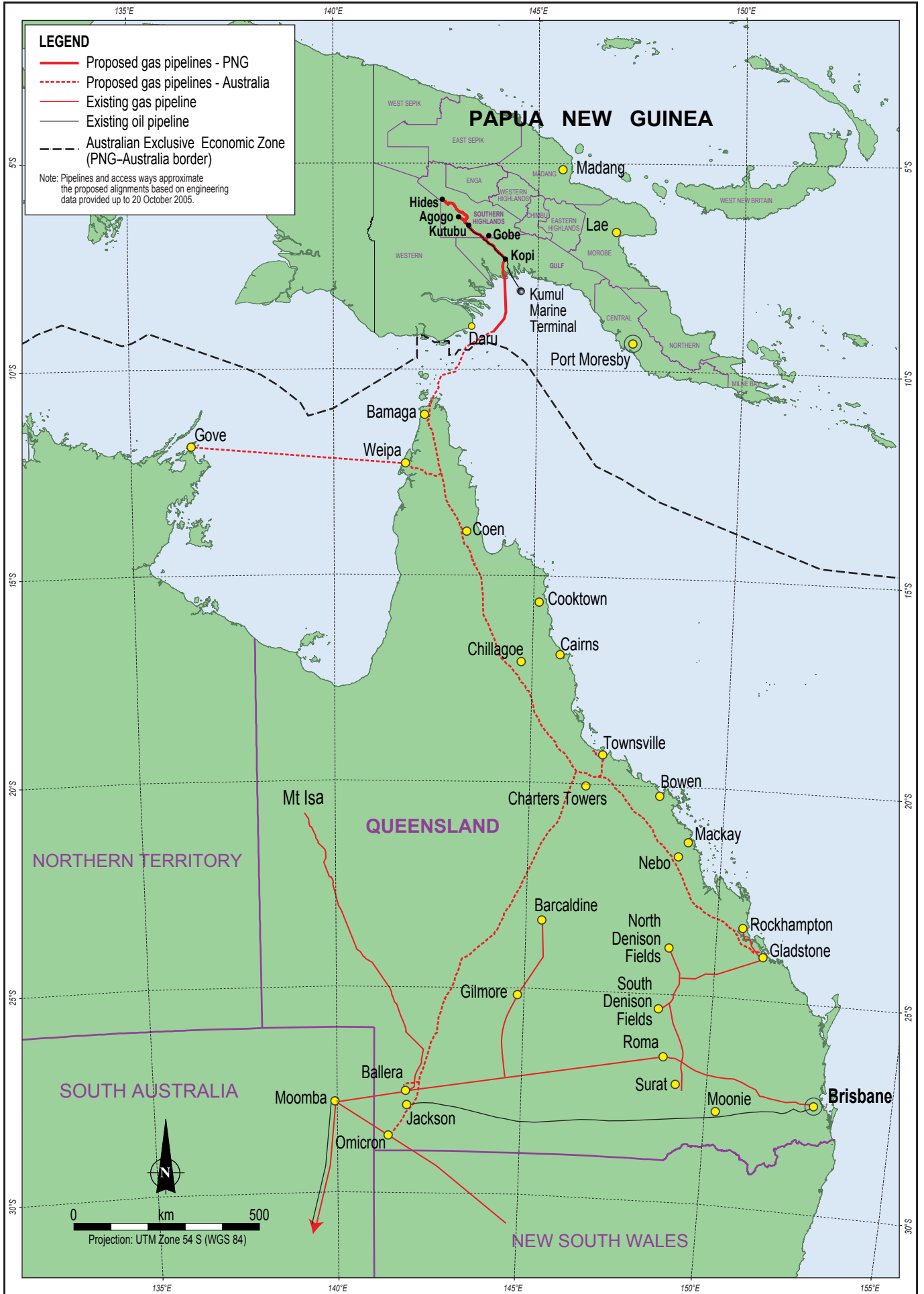
The legal and fiscal parameters of the PNG Gas Project and the provision for State participation in the project are set out in the PNG Gas Project Gas Agreement executed in 2002 between the co-venturers, the Independent State of Papua New Guinea and the Bank of Papua New Guinea.

The Gas Agreement contemplates that operations involving gas recovery at Kutubu, Gobe, Moran and Hides will be part of a coordinated development under the *Oil and Gas Act 1998*. The Gas Agreement also provides that the PNG Gas Project may complete the pipeline construction RoWs as a public road link from Tari to the Gulf coast at Kikori and requires the State to build new sections of road so as to complete an eastern link from Mendi and Mt Hagen to Kikori.

2. Development Timetable

The PNG Gas Project schedule is predicated on producing 225 petajoules (PJ) of natural gas per year. The nominal project life is 30 years, with first gas scheduled to be available for delivery to customers in Australia in 2009 after a three-year construction period starting in 2006. Further developments between 2011 and 2029 will add compression and additional wells at Hides and new sources of gas.

¹ This employment figure excludes contract service providers.



3. Project Setting, Facilities and Impacts—Onshore

3.1 Onshore Setting

The environment in which the PNG Gas Project is located ranges from the northwest–southeast trending ridges and ravines, karst and incised volcanic landforms of the higher elevations of the Papuan Fold Belt (Figure ES4) to the Kikori Basin lowlands and delta landforms of the Gulf of Papua (Figure ES5).

The project area lies within the catchment of the Kikori River system and features extensive tracts of relatively little-disturbed and sparsely populated moist tropical forest of at least 19 different broad types. Previous surveys undertaken by the World Wide Fund for Nature (WWF) and new surveys commissioned for this EIS have determined that the Kikori River basin contains 79 species of non-flying mammals, 46 species of bats, 389 species of birds and 90 species of frogs. A further 30 species of bats and 155 species of birds could also occur in the area.

Notable species include birds-of-paradise, cassowaries, fruit doves, tree kangaroos, microhylid frogs, fruit bats and orchids. A number of groups within the fauna are narrowly distributed according to altitude, and a number of species have localised and somewhat restricted occurrences.

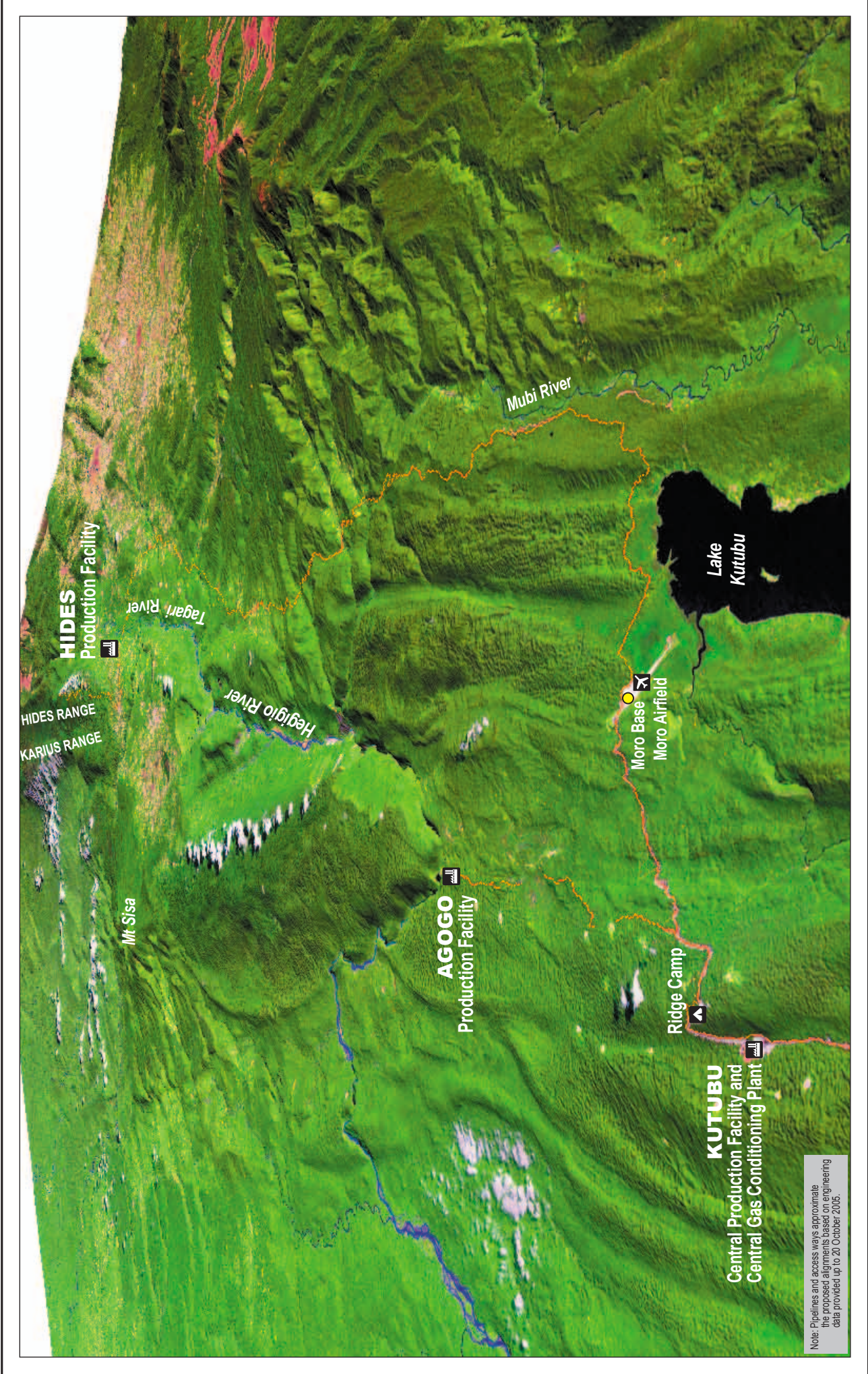
Mean annual rainfall varies across the project area, from 2,500 mm at Tari to 4,500 mm at Kutubu and 5,700 mm at Kikori, with relatively low runoff and high infiltration through the karst landforms and thence into aquifers and underground rivers. Smaller rivers through volcanic terrain and the numerous larger rivers carry high sediment loads during higher flows, and there are some areas of impeded drainage, with swamps.

Remoteness, soil infertility and endemic malaria have kept human populations at low densities, and so there has been limited hunting and forest clearing pressure over most of the project area to date.

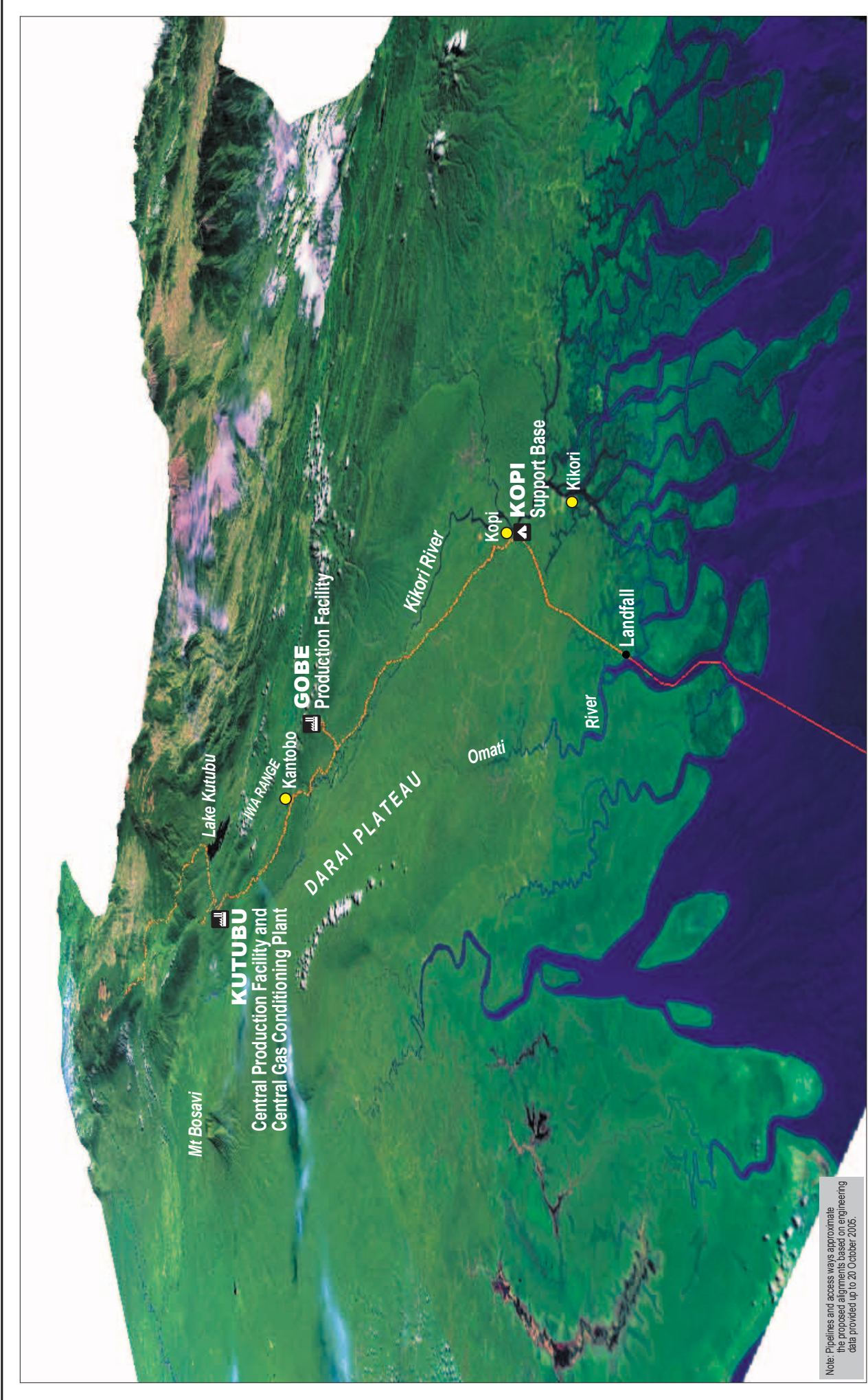
Most of the listed and restricted fauna species are generally under hunting pressure across their range in PNG, with critically endangered species comprising several mammals and one plant. No bioregion and no particular part of the project area traversed by the sales gas pipeline has a concentration of listed species.

Industrial development to date in the Kikori River basin area has involved the oil and gas industry and large-scale commercial logging. With localised exceptions around the main petroleum production facilities at Kutubu and Hides, the historic pattern of sparse population has generally persisted since oil and gas production began in the early 1990s.

There is evidence that the biodiversity effects of these industries have been limited and localised to the areas of direct disturbance. The PNG Gas Project will broaden to a limited extent the development footprint at the extremities of the existing oil and gas infrastructure and extend the life of the industry in the region by several decades.



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|  | | Job No: 790 File No: 790_20_FES4_HB | PNG Gas Project Esso Highlands Limited | Figure No: ES4 |
| | | Digital elevation model: Hides to Kutubu | | |



Note: Pipelines and access ways approximate the proposed alignments based on engineering data provided up to 20 October 2005.

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|  | Job No: 790 | PNG Gas Project | | Digital elevation model: Kutubu to landfall | Figure No: ES5 |
| | File No: 790_20_FESS_HB | Esso Highlands Limited | | | |

In general, the conservation values of the project area are high; and numerous local-scale landform features, such as sinkholes, spires, towers, caves, springs and waterfalls, are to be found. However, these values and features are not uniformly at risk from the project. Accordingly, five noteworthy areas have been identified for which priorities for management and the application of appropriate mitigation measures have been defined. These areas are:

- The lower montane forest with *Nothofagus* on the karst of Hides Ridge—plant and animal diversity.
- Sinkhole swamps on Hides Ridge (frogs).
- Caves (bats).
- Swamp forest—specialist vertebrates (birds, turtles, crocodiles).
- Stream banks and riparian vegetation at higher elevations—specialist vertebrates (birds and frogs).

3.2 Onshore Facilities and Travelogue

Hides Gas Field and Spine Line (Gas and Liquids)

In the northwest at elevations between 1,800 m and 2,800 m exists the polygonal karst of Hides Ridge (Figure ES4). Initially, three new wells will be drilled and three existing wells will be recompleted on Hides Ridge. The wellstreams will be gathered in a 550-mm spine line buried in a RoW nominally 12 m in width. Substantial earthworks are required to construct the RoW, and these earthworks will often extend the total width of the area cleared. A further five wells will be drilled on Hides Ridge in two subsequent drilling campaigns.

There are currently two existing gas production wells and their flowlines and two undeveloped exploration wells on Hides Ridge, but the area is otherwise little disturbed. Frequent cloud cover makes for a consistently moist climate, and the trees on the ridge are festooned with epiphytes. The biodiversity on Hides Ridge is notable: the vegetation is relatively intact, has few noxious weeds, is rich in ferns and includes 12 new plant species; the fauna is diverse and notable for high-altitude birds, bats and frogs and an abundance of arboreal mammals; the sinkhole swamps have a rich and restricted frog fauna. Similar habitat is to be found on adjacent mountains and ranges to the southwest and northwest.

The EIS identified Hides Ridge as an area warranting focused environmental planning and management attention. This has included an assessment of the option to drill wells from the valleys on either side of the ridge in order to avoid the top of the ridge altogether (technically infeasible) and to develop the field using lower-impact, helicopter-supported high-manual-labour methods (complex, with serious cost, schedule and safety drawbacks). These studies indicated that there were no technically feasible alternatives that offered a significant environmental benefit.

From Hides Ridge, the spine line will descend through cleared and settled country to the proposed Hides Production Facility on the south bank of the Tagari River at an elevation of approximately 1,250 m ASL. The Hides Production Facility will separate the raw gas

into rich gas and natural gas liquids (mainly condensate) streams, which will flow separately via two new pipelines to the proposed Central Gas Conditioning Plant at Kutubu.

Hides to Kutubu

The two new pipelines from the Hides Production Facility will run to the Kutubu Central Gas Conditioning Plant (Figure ES4). Between Idauwi and Homa, existing roads will be linked by the construction access way/RoW to form a public road.

Much of this area is partly cleared and settled, but the RoW encounters forested, steep, incised volcanic terrain between the Maruba and Pawgano rivers. Major earthworks in this locale raise the issue of forest clearing, spoil management and the impact of construction-generated sediment on watercourses. There are also a number of archaeological and cultural heritage sites to be negotiated in this area.

The geology reverts to limestone and gentler terrain as the RoW follows the existing road from Homa to Moro around the northern end of the Ramsar-listed Lake Kutubu catchment. From Moro, the RoW crosses a ridge to the new Kutubu Central Gas Conditioning Plant at approximately 960 m ASL. Here, gas and liquids from Hides will be separated, and the gas from Hides and from the existing oil production operations will be processed. Gas will be conditioned to export specification and will be sent via the new sales gas pipeline to customers, initially in Australia. LPGs from the Central Gas Conditioning Plant will be reinjected for possible future production or used as fuel gas in the process. The Hides liquids will be transferred from the Central Gas Conditioning Plant for stabilisation at the nearby existing Kutubu Central Production Facility and from there will flow via the existing crude oil export pipeline to the Kumul Marine Terminal in the Gulf of Papua.

Kutubu to Kopi Sales Gas Pipeline

The sales gas pipeline will run from the Central Gas Conditioning Plant generally within the easement of the existing crude oil export pipeline and, south of Gobe, the existing road between Gobe and Kopi (which parallels the existing oil pipeline easement). Some existing roads will be upgraded by the project in this area, and some new sections of access way will be constructed (Figure ES5).

From Kutubu, the sales gas pipeline RoW will initially step down over successive ridges through lowland hill forest to the Ai'io River, before continuing over flatter karst terrain through swamp forest and woodland and finally descending the last escarpment to the confluence of the Mubi and Kikori rivers. At this location, the construction access way and future public road will deviate to the west between KP 55 and the Mubi River (in order to maintain a trafficable grade), while the sales gas pipeline RoW will stay within a steep section of the existing crude oil export pipeline easement.

From the Mubi River to Kopi, the rejoined RoW and access way will follow the existing crude oil export pipeline ROW along the floodplain of the Kikori River through lowland hill forest on limestone pavement and karst featuring some caves and pinnacles to the Kopi Support Base.

The key areas of management focus in this section will be the protection of bat caves and sites of high archaeological and cultural significance in the Kopi area (see below).

Kopi Support Base

The existing Kopi Support Base and wharf will be extended and upgraded by the PNG Gas Project. These works will also need to negotiate archaeological and cultural sites, for which a detailed ground survey is currently underway.

Kopi to Omati Sales Gas Pipeline

The sales gas pipeline will run the final 34 km from Kopi through lowland forest on karst plains, then across the Veiru Hills and through the increasingly swampy ground of the delta to a nypa palm-fringed landfall on the Omati River.

3.3 Onshore Issues, Proposed Mitigation Measures and Residual Impacts

Biodiversity Conservation

The direct biodiversity impacts of the construction and presence of PNG Gas Project facilities will be felt primarily as limited and localised habitat loss due to clearing and barrier effects. Based on the experience of the existing petroleum developments in the Kikori River basin, rapid natural revegetation of reclaimed earthworks is anticipated. Accordingly, project-related impacts on flora and fauna will be limited and localised.

The main impact on flora and fauna will be habitat loss at the time of construction, in particular on Hides Ridge. The operations phase of the project will require a 7-m-wide access track to service the gas wells, but the remaining construction-disturbed land surfaces will be allowed to revegetate. Natural revegetation has occurred quickly at lower elevations but will take more time in the cool climate associated with Hides Ridge, where active measures may be needed to accelerate the process. The RoW on Hides Ridge threads a path through the karst terrain, and earthworks spoil has been estimated to potentially affect up to 46 sinkholes. These sinkholes cover an area of between 3 and 6 ha out of some 130 ha of sinkhole habitat on Hides Ridge. Extensive analogous high-altitude polygonal karst habitat also exists on the Karius Range to the southwest and to the northwest. In this context, the overall impact on Hides Ridge sinkhole habitat has been predicted to be low to moderate, limited in extent, and of medium- to long-term in duration. It is worthy to note that only a small portion of the sinkholes in the Hides Ridge area that will be impacted by sidecast spoil contain sinkhole swamp habitat.

Of the other noteworthy areas or features in the project area, the swamp forest habitat will not be adversely affected provided appropriate drainage is maintained; measures to this effect are proposed to be adopted. Caves and resident bat populations will be protected to the extent practicable by performing surveys ahead of construction and implementing appropriate blasting procedures. Completed watercourse crossings will be reclaimed.

The existing petroleum developments have shown direct impacts to have been restricted to the very close proximity of facilities. Indirect impacts, on the other hand, have a potential to extend beyond the development footprint unless properly managed. These

impacts include fire, dieback, weeds, animal pests, and improved access potentially promoting in-migration and enhancing logging, hunting and forest clearing activities. Indirect impacts can also be long term, and so consistent and prolonged monitoring and management by the State is required over the life of the project.

An assortment of mitigation measures associated with biodiversity conservation and construction earthworks has been proposed to reduce residual direct impacts to low or negligible levels.

Aquatic Environment

The Hides Ridge sinkholes discussed above aside, the principal and only material impact that the project is anticipated to have on the aquatic on-shore environment will take place in the steep terrain and volcanic soils over a 14-km section on the new road between Idauwi and Homa. Here, the sedimentation and turbidity effects of construction earthworks on the aquatic ecosystem of watercourses will be major in the short term (less than one year) but restricted to a site scale (within 2 km), with moderate and low impacts at the local scale (2 to 10 km). Within 3 years following the earthworks, recovery will be essentially complete. None of the areas in the vicinities of the project's major earthworks is inhabited.

Post-construction monitoring and appropriate erosion control measures will be implemented when and where required to facilitate the natural revegetation of reclaimed construction-disturbed land surfaces. Active revegetation techniques will be employed where natural revegetation is assessed to be inadequate. Impacts on the on-shore aquatic environment are predicted to fall to negligible within the medium term of between two and five years.

No residual impacts are predicted for other watercourses and water bodies in the project area, including Lake Kutubu.

Noise, Air Quality and Greenhouse Gas

Modelling has determined that noise and air emissions associated with the PNG Gas Project will be non-problematic. Greenhouse gas emissions have been calculated and reported under the PNG protocol.

4. Project Setting, Facilities and Impacts—Offshore

4.1 Offshore Setting and Travelogue

The offshore sales gas pipeline will run through the low-lying, swampy prograding delta complexes at the head of the Gulf of Papua out across the muddy seabed of the Gulf itself and around the delta front of the Fly River to the reefs, cays, small continental islands, and shoals of Torres Strait.

Gulf of Papua

Regardless of its pathway, the sales gas pipeline must traverse or negotiate the same four features of the seabed in the Gulf of Papua: the unstable delta front of the Fly River; the otherwise generally muddy, stable Gulf seabed, interspersed with dead trees; prawn trawl grounds; and the hard carbonate shelf with extensive areas of the calcareous alga

Halimeda beyond the zone of sedimentation. There is no route in the Gulf that avoids the almost ubiquitous muddy seabed; but, equally, from an environmental impact point of view, there is no reason to do so. Hence, alternative alignments for the offshore sales gas pipeline in the Gulf were not investigated. In fact, the line of the shortest route takes the pipeline to the west, and this has the effect of reducing the overlap with the main prawn trawling grounds to the east and avoiding the *Halimeda* beds.

Torres Strait

The pipeline routing criteria in the Torres Strait are well aligned from an engineering and environmental standpoint: the shortest route that avoids coral reefs and shipping channels and that limits the disturbance of seagrass beds. The entrance to the Strait through PNG waters is environmentally and economically unconstrained as the pipeline enters the Torres Strait Protected Zone (TSPZ).

The TSPZ exists to manage fisheries and enable customary use of and movement through Torres Strait under the joint authority of Papua New Guinea and Australia.

Crossing the international boundary near Pearce Cay, the pipeline encounters the platform massif of the Warrior Reefs, which runs north–south for more than 100 km. The pipeline must cross from east to west through one of a number of natural breaks, as the passage around its southern extremity is constrained by shallow sections of shipping channels. Four transits of the Warrior Reefs were assessed under Australian and Queensland environmental assessment processes, and one was selected and approved in 1998 (North Central [‘Basilisk’] Passage). However, subsequent consultation revealed that the Basilisk Passage was constrained by its cultural heritage and, at the request of its Islander custodians, a route further to the south has been nominated, approved by Australian Commonwealth and Queensland authorities and adopted for detailed engineering survey and design by the proponents of the Australian portion of the sales gas pipeline (South Central Passage [‘Bet Reef’]).

4.2 Offshore Issues, Mitigation Measures and Residual Impacts

Route selection to reduce overlap with prawn trawling grounds, to avoid coral reefs, and to reduce the extent of seagrass beds traversed has been the principal mitigation approach adopted for the offshore sales gas pipeline.

During operations, there will be no requirement for an exclusion zone for trawlers around the pipeline, which will mostly sink into the soft seabed. Residual impacts on the marine environment are predicted to be negligible.

5. Social Setting and Impacts

5.1 Population, Land Use and Social Organisation

The PNG Gas Project area is one of the most remote and least accessible parts of Papua New Guinea. The region supports a generally sparse local population, which operates a generally subsistence economy based on sago palm cultivation, slash-and-burn agriculture, and hunting, gathering and fishing.

The project impact area has a diverse sociocultural character, with numerous tribal and language groupings. Social organisation is mainly based on patrilineal descent, which

determines all of the important relationships of people to people, people to land, and people to their spiritual beliefs.

The project impact area has a very low potential for broad-acre commercial agriculture, and none has developed.

For the proponents of new projects, the most important feature of PNG society is the primacy of small clan groups and their customary ownership and control of land.

5.2 Economics and Politics

The principal sources of cash income in the project impact area are wages and royalties from the oil developments and, to a lesser extent, from commercial logging in the Gulf lowlands. The PNG Gas Project will not necessarily increase the quantum of benefits, but rather will extend their geographic scope and term. As far as all those who own land are concerned, the amount, destination and use of project revenue streams is the PNG Gas Project's single biggest socio-economic issue.

The negotiation of project benefits between the different levels of government and landholders is mandated by legislation and codified in a formal and structured process. This provides for the negotiation of agreements regarding the sharing of resource project benefits between the various levels of government and landowners and for a process by which the State will manage this distribution.

5.3 Social Change

The oil and gas industry in PNG spans a decade and a half to date and has provided infrastructure, service, wealth, training and employment opportunities to the project area.

These have accelerated the pace of social transformation to modernity: new forms of representation have arisen; access to non-traditional economic, political and jural institutions has increased; and commercial business developments with shareholding constituencies, democratic decision-making and monetary responsibilities have been created.

National and local PNG constituencies continue to welcome the developments that bring about such changes—in the project impact area, landowner support for the PNG Gas Project is greater than 82%.

5.4 Issues

The social issues most articulated in attitude and opinion surveys carried out by the PNG Gas Project in the project impact area have been:

- The ability of the government to ensure that landowners' interests are reflected in representative and accountable entities and that benefits are equitably distributed.
- Social service delivery.

These issues are all matters for government and are beyond the purview of the PNG Gas Project.

The PNG Gas Project will continue the process of social change in the project impact area, and the improved public road system associated with the project will increase

mobility, access to services and commercial opportunities. On the other hand, the road could lead to higher crime, prostitution, and rates of sexually transmitted diseases (including HIV/AIDS) in the project impact area and a number of other social challenges that government will need to address.

In the longer term lie questions of economic dependency and options for sustainable business and services in the future.

5.5 Proposed Mitigation Measures and Residual Impacts

The State has the responsibility for managing the main social issues related to the PNG Gas Project, especially the vehicles for local participation, governance and equity of benefit and service distribution processes.

These processes have been underway for some time and are the subject of renewed rounds of explanatory presentations and consultations in the villages and towns of the project impact area carried out by government agencies with the assistance of project personnel.

Social impacts in the project impact area within the purview of the PNG Gas Project to mitigate directly lie in the following areas: accessing labour via the NECL and existing landowner companies; contributing to health, education and agricultural initiatives (especially those targeted at women); avoiding cultural property and spiritual places; payment of legislatively required compensation in a fair and transparent manner; and consulting with local communities. In-principle mitigation measures related to these matters are proposed in the EIS.

6. Public Consultation

Public consultation in the project impact area is an ongoing process involving routine interactions, formal presentations and ad hoc meetings. Public attitudes and opinions about the PNG Gas Project and other issues have been documented to a large extent through a comprehensive household survey, which achieved a population coverage of approximately 40%.

A variety of non-governmental organisations have been included in the project's publication consultation program, including international and local organisations and faith-based groups.

7. Cumulative and Associated Impacts

Cumulative impacts arise at particular places in the project area as a result of the activities or initiatives of others, but are in some way related to the PNG Gas Project.

As far as forestry is concerned, the presence of an improved public road associated with the PNG Gas Project could provide a small fraction of the road requirements of one of the forestry blocks in the project area at no cost to the concession-holder, but this situation was assessed as being inconsequential in determining whether commercial logging in this forest management area would be encouraged or accelerated. In general, the forest industry makes its own commercial and environmental arrangements and has had very little overlap with the oil and gas sector.

The improved public road system associated with the project gives rise to several potential environmental risks, including increased forest clearing, wildlife hunting and poaching, fire and noxious weed invasion. Settlement along the road, however, is anticipated to continue to be severely constrained by the inhospitable, unproductive and malarial environment, as well as social norms discouraging squatting.

Similarly, the drivers for mass migration via the improved road system are not evident, and major spontaneous resettlement is not expected. Much will depend on the extent to which commercial opportunities created by the road are grasped.

Associated impacts have been defined as those arising outside the project area from the activities of other parties that are dependent on the PNG Gas Project. Some involve the possibility of creating value-adding gas-fueled industries within Papua New Guinea. A number of such developments are being explored by others, with encouragement from the State, but are not sufficiently defined at this time. These ventures will require their own environmental assessments and development approvals in due course. In Australia, the displacement of coal and fuel oil by PNG gas will reduce CO₂ emissions by approximately 1.8 million tonnes of per year (with a net reduction after taking into account the gas production-related emissions of approximately two-thirds of this amount).

8. Management and Monitoring

The proposed mitigation measures appearing in the EIS are anticipated to be implemented progressively during the project's preconstruction, construction and operations phases within a framework featuring a multi-module Environmental Management Plan (EMP).