CONTENTS

Figures

Tables

Plates

5. PROJECT LOGISTICS

The PNG LNG Project is to be built across a large and diverse project area, in which existing transport infrastructure is limited or non-existent. An integrated whole-of-project logistics infrastructure strategy is needed before and during the work of constructing the field production facilities, pipelines and gas processing plants to make development of the project possible.

Ocean ports on the northeast and south coasts of Papua New Guinea will be used to import materials and construction equipment; airports and airfields will be required for inter- and intra-country personnel transport and airfreight, particularly heavy and shock-sensitive loads; and new and upgraded roads will be needed to link ports and airfields to construction sites.

There will need to be laydown and storage areas for materials and equipment, fuel depots, accommodation for workers and a range of ancillary facilities to support construction of the project logistical strategy.

The main works proposed to support the construction logistics strategy (Figure 5.1) will most likely include:

Upstream Project Area

- A new wharf and facilities upgrade at Kopi, which will be the primary logistics centre for the pipeline construction activities.
- Laydown and warehousing areas at the Port of Lae.
- Logistics roadworks will entail constructing or upgrading:
  - 191 km of roadway and 24 bridges or culverts from Kopi to the Moro–Mendi road turnoff.
  - Most likely upgrading a 25 km section of the Highlands Highway (also known as the Okuk Highway) from Poroma to Mendi.
  - Upgrading 4 bridges on the Highlands Highway.
  - Upgrading 263 km of the road (including 25 bridges) from the Moro ring road turnoff to Idauwi via Poroma and Tari.
  - Upgrading 38 km of roadway from Idauwi to Komo via the Hides Gas Conditioning Plant (including 3 bridges) to provide upstream logistics routes to the construction areas.
- Constructing 45 km of new, temporary access tracks to the gas and oil fields to be developed.
- Upgrading Komo Airfield and making improvements to the existing Tari Airfield (which will be used only for personnel transfers during the construction phase of the project).
- Constructing temporary camps, laydown and storage areas and fuel depots.
- Installing telecommunications and establishing water sources and other utilities at the various logistics facilities sites as required.

Figure

5.1 Ports, logistics routes and laydown facilities

LNG Facilities

- The Materials Offloading Facility at the LNG Facilities site, which will receive oversized or heavy freight via barge from Port Moresby.
- Laydown and warehousing at Port Moresby.
- Upgrading Lea Lea Road between Port Moresby and the LNG Facilities site and constructing a bypass for this road around the LNG Facilities site (see Sections 4.2.1.5, Public Road Upgrade from Port Moresby to the LNG Facilities Site and 4.2.1.6, Rerouted Public Road).
- Constructing temporary camps, laydown and storage areas and fuel depots.
- Installing telecommunications and establishing water sources and other utilities at the various logistics facilities sites as required.

These works and those associated with the development of the Kutubu and Gobe gas developments will take place before and during the project's Phase 1, with additional roadway upgrades and new construction to access new gas fields at the start of Phase 2 (additional drilling at Hides and Angore gas fields), Phase 4 (Juha gas field development) and Phase 5 (associated gas field developments at Agogo, Moran and South East Hedinia).

Figure 1.3 shows the indicative construction schedule for the logistics infrastructure.

While this chapter describes the project's overall logistics strategy, there is a focus on the logistics elements that support the development of the upstream project components. Details of the logistics to support development of the LNG Facilities site are described in Chapter 4, Producing and Exporting the LNG. The Materials Offloading Facility is described in Section 4.3.3, and its construction and operation in Section 4.6.4, Constructing and Operating the Materials Offloading Facility. The road upgrades between Port Moresby and the LNG Facilities site, and the rerouting of the Lea Lea public road around the LNG Facilities site are described in Section 4.2.1.5, Public Road Upgrade from Port Moresby to the LNG Facilities Site and 4.2.1.6, Rerouted Public Road respectively. The pioneer and construction camps and associated facilities are described in Section 4.6.5, Constructing the Phase 1 Construction Camp.

5.1 Logistics Strategy

5.1.1 Overview of Logistics Routes

The logistics strategy aims to spread the influx of cargo for the PNG LNG Project between Port Moresby and Lae so as not to overburden either port. This section describes both upstream and LNG Facilities site marine elements of the strategy.

Initial mobilisation of construction and camp equipment is proposed to be from the existing ports of Lae (for on-shipment by road) and Port Moresby (for on-shipment by barge, road or air). Upstream personnel will most likely be mobilised primarily by air to existing airfields at Gobe and Tari (and also Moro and Komo as the pioneer camps are developed), and initially accommodated at either the existing oil production or new pioneer camps.

This logistics strategy (see Figure 5.1) involves transporting materials and equipment:

- Overland from Lae to Hides via the Highlands Highway to Poroma and then via the ring road (see below) through Tari and Idauwi to Hides. This route is termed the northern logistics route.
- By barge from Port Moresby to Kopi Shore Base and then overland from Kopi to Moro via the ring road to Hides. This route is termed the southern logistics route.
- Either overland or by barge from Port Moresby to the LNG Facilities site.
- By air from Port Moresby to Komo Airfield and then by road to Hides.

The ring road is a section of public road connections that runs south from Moro, east to Poroma, northwest to Tari, southwest to Idauwi and then west to Hides (see Figure 5.1).

5.1.2 Overview of Logistics Loads

A preliminary assessment identified the respective loads the material and equipment loads that will be transported over the main logistics routes. These are summarised in Table 5.1.

Table 5.1 Indicative logistics routes and their proposed loads

Equipment/Supplies/Personnel	Indicative Primary Route	Indicative Back-up Route
Drilling and upstream facility normal construction loads, including drill rigs and other normal truck deliveries to the Hides Gas Conditioning Plant.	Northern logistics route	Southern logistics route
Hides Gas Conditioning Plant heavy and oversized loads.	Southern logistics route	Northern logistics route Komo Airfield to Hides
Onshore pipeline loads, i.e., the line pipe and associated materials, equipment and construction machinery.	Southern logistics route	Northern logistics route
Personnel and light freight	Komo Airfield to Hides Tari Airfield (personnel only) Gobe Airfield (personnel only)	
All LNG Facilities site loads	Port Moresby to the LNG Facilities site Jacksons International Airport, Port Moresby	

5.2 Logistics Infrastructure

5.2.1 Access via Water

Both the upstream and the LNG Facilities site logistics systems will have access by sea: the former may use Port Moresby, Lae and Kopi Shore Base with on-shipment by road or air; the latter may use Port Moresby with further on-shipment initially by road and, later in construction, via a barge to the wharf (the Materials Offloading Facility) at the LNG Facilities site.

5.2.1.1 Port Moresby and Lae

Port Moresby, on the south coast of Papua New Guinea, will be the primary point of import for most of the line pipe and associated onshore pipeline and equipment, the 'heavy and oversized loads' for the Hides Gas Conditioning Plant and all the equipment and materials required for construction of the LNG Facilities site. It will also provide back-up for the drilling and normal construction loads to Hides.

Lae, on the northeast coast, will be the primary point of import for the drilling equipment and facility normal loads destined for the Hides Gas Conditioning Plant; it will also provide a possible back-up for the heavy and oversized loads for the Hides Gas Conditioning Plant and for the onshore pipeline loads.

International commercial freight services currently operate at both Port Moresby and Lae.

Stevedoring in PNG ports is handled by private companies, licensed by the PNG Harbours Board.

Laydown or warehousing areas will be established at both Port Moresby and Lae. Major upgrades are not required.

5.2.1.2 Kopi Shore Base

Kopi will service the onshore pipeline contractor. Cargo (including fuel and local purchases) will be transported to the Kopi Shore Base by sea-going, self-propelled barges from Port Moresby to the Gulf of Papua (see Figure 5.1) then through the Kikori River delta to Kopi (Figure 5.2).

Alternatively, ships may moor near a site, such as the Paia Inlet, and transfer the cargo to lighters for transport to Kopi via the Kikori River. The bulk of the transportation from Port Moresby to Kopi will take place over three years, i.e., from the second half of 2009 to 2012, at a frequency of approximately 2.7 trips per week.

Arrangements for on-board customs clearance and quarantine at Kopi are envisaged to handle arrivals direct from overseas ports. The quarantine station at Kopi will be similar to the stations set up at Lae and Port Moresby, but is likely to be on a smaller scale.

The PNG Parliament is considering four new marine pollution bills (see Section 8.2.5.1, Other PNG Environmental Legislation and Regulation) that, if adopted, will bring PNG law into line with international standards. These standards may include the provision for waste reception facilities at all PNG ports, including the Kopi Shore Base, and will provide for the reception of waste oil, noxious liquids, sewage and garbage, and its appropriate disposal.

Procedures will be established to comply with legislation if and when the Kopi Shore Base is deemed to be classified a 'major port'.

Existing Facilities and Infrastructure. The Kopi Shore Base was used as a construction camp during the installation of the crude oil export pipeline and serves today as a logistical centre for materials arriving by barge that require transport to Gobe or Kumul Marine Terminal to support Oil Search Limited's existing operations.

Figure

5.2 Indicative project barge route to Kopi Shore Base

The base is located on the Kikori River, approximately 55 km due north of the Gulf of Papua. The site is generally swampy, but there are limestone pillars that can support heavy loads without piles.

The existing wharf facilities on the Kikori River provide four arrangements for berthing vessels:

- A main wharf, used for normal operations at Kopi for the supply of materials, consisting of a straight jetty approximately 15 m long and 8 m wide, perpendicular to the river.
- A disused, small upstream wharf.
- A downstream wharf, occasionally used for berthing of island trader vessels.
- An earthen bank roll-on and roll-off vessel access.

Modifications to Kopi Shore Base. Figure 5.3 is an indicative layout for modifications at Kopi Shore Base, with a nominal expansion by 16 ha to accommodate a fuel depot; camp; new 200-t capacity, 30-m-long, steel and concrete barge wharf upstream of the existing main wharf; extended laydown area adjacent to the new wharf; refurbishment of the existing main wharf; and a new roll-on, roll-off barge ramp. Planning provision is also made for laydown areas for onshore and offshore pipeline contractors and camp site for the onshore pipeline contractor. The final arrangement will depend on how many of the heavy and oversized loads can be transported through Lae but is expected to remain within the area previously surveyed for archaeological and cultural artefacts in 2005 and 2006 (Enesar, 2005). Sites of known archaeological and cultural significance are tabulated in Chapter 22, Project-wide Cultural Impacts and Mitigation Measures.

Targeted salvage of archaeological sites has been undertaken at and in the environs of Kopi to both remove and protect identified cultural constraints ahead of future earthworks at the site. These surveys are reported in Part 4 of the SIA (Appendix 26, Social Impact Assessment). The locations of sites to be avoided and protected was input to the project geographic information system and will be used in future when deciding the layout of the facility components in the detailed design phase.

The wharf will be designed to facilitate unloading and loading of materials and equipment from shipping barges, including the heavy-load modules for the Hides Gas Conditioning Plant and the pipe for the onshore pipelines. It is configured as a landing platform projecting outward from the river bank, with a wharf frontage of approximately 30 m for berthing of barges.

5.2.2 Access via Air

Passenger air travel and transporting freight by air are already normal transport methods across Papua New Guinea, and the PNG LNG Project will make considerable use of this mode of transport. Some upstream construction workers will travel to site by aeroplane to Moro, Tari or Komo, with further air travel via helicopter to Kopi, Gobe, Hides or Juha (see below). PNG-based skilled workers will be flown from Jacksons International Airport or Mt Hagen to Moro, Tari or Komo airfields on chartered aircraft.

Some upstream expatriate project workers may fly directly to Moro from Cairns.

Figure

5.3 Existing facilities and indicative layout of new facilities at Kopi Shore Base

5.2.2.1 Airports

Port Moresby's Jacksons International Airport will be the primary port of entry for expatriate workers on rotation, and for air freight, with Nadzab Airport near Lae available as a back up. Onward air freight will generally be to Tari, Moro, Gobe or Komo and, from there, by road to their respective construction sites (or from Port Moresby to Kopi by watercraft).

5.2.2.2 Airfields and Helipads

The project will be constructed and will operate in remote areas where there are currently no local medical services and few roads. Komo Airfield will be improved and expanded for scheduled transportation. Two new stand-alone helipads (at Hides and Juha) and an existing helipad at Kopi will be used for emergency medical evacuation during construction. During pipeline ROW construction, cleared and graded final valve and cathodic protection station helipads will be available for emergency use. The Hides and Juha helipads will be retained for personnel transport and medical evacuations during operations as well as routine pipeline inspection and maintenance.

Cargo aircraft will be used to transport freight. Medium twin-engine helicopters will be used for offshore construction crew changes, emergencies (such as medical evacuations) or where flooding has closed roadways or airfields.

Tari Airfield

The existing public Tari Airfield facilities will most likely by required only during construction of the project. The following improvements are required to modify Tari Airfield to safely process the required passenger volume and meet ExxonMobil's Aviation Operation Standards by using a DHC-8 aircraft:

- The runway will be smoothed with initial and ongoing rolling and maintenance.
- Airfield fence and security will be assessed against project security guidelines.
- Tall trees (greater than 32 m) will be removed to reduce obstacles on take-off.
- Terminal facilities will be assessed for staffing requirements of approximately of 30 personnel.
- Development of a GPS Non-Precision Approach will be investigated.
- Availability of emergency fuel for the aircraft will be considered.

Komo Airfield

Komo Airfield has been preliminarily selected as the site for the project airfield to support the operation of the Hides Gas Conditioning Plant and the future Juha gas field developments. Komo is located about 10 km southeast of the Hides Gas Conditioning Plant and there is an existing unsealed rural road connecting it to the proposed plant site (travel distance is approximately 20 km). Komo has been used in the past to support gas exploration activity and there is an existing airfield at the site.

Airfield infrastructure at Komo is to comprise:

- A 1,900-m-long by 30-m-wide runway, with a preferred north-northwest alignment, suitable for the Dash 8-315 aircraft.
- Apron and other associated airfield facilities.
- Helipad designed for a Bell 412 or equivalent (added to the apron).
- A hangar for one Dash 8-315 aircraft, with access to the apron area.
- Passenger terminal building to service the fixed wing passenger aircraft and helicopters, including provisions for security screening, passenger and cargo check-in, baggage handling, passenger and crew amenities, briefing room, communications centre and offices for air crew and ground staff. This building will also contain a medical room.
- Rescue and fire fighting facilities, services building, including emergency services office.
- Fuel storage and dispensing facilities.
- Site utilities and services, including water supply, sewage system and electricity generation.
- Security fencing and guardhouse.

A 2.4 m galvanised chain mesh security fence will also be installed around the boundary of the airfield. It will be located approximately 105 m off the centreline of the runway (each side) and around the facilities. There will be a clearing 10 m beyond the fenceline. The security fenceline will cover an area of approximately 89 ha, with some extensions on one side to accommodate the airfield apron and instruments.

The design and construction of the airfield will comply with:

- Requirements of the Civil Aviation Authority of Papua New Guinea.
- The International Civil Aviation Organization (ICAO) Annex 14.
- ExxonMobil Aviation Operations Guide.

Extra runway length may be needed for safety and operational reasons and if required, can be accommodated within the areas of the facility security fence.

Gobe Airfield

The existing Gobe Airfield and heliport is owned and operated by Oil Search Limited, the oilfield operator. It is likely that this airfield will be upgraded to support the operation of Dash 8-315 aircraft. The following improvements may be required:

- Extension and widening of the runway and runway strip (aggregate, unsealed runway).
- Provision of sufficient clearway and stopway; and runway lighting to facilitate precision approach landings and the night departure of the aircraft for medical evacuation.
- Increased width of the taxiway and additional redundant taxiway access to the runway; and the apron area to cater for anticipated worst-case aircraft movements.
- Plot space for one Dash 8-315 size temporary hangar facility with access to the apron area.

- Tower and terminal facility upgrading to service the fixed wing passenger aircraft and helicopters, including provisions for security screening, passenger and cargo check-in, baggage handling, passenger and crew amenities, briefing room, communications centre and offices for air crew and ground staff. This building will also contain a medical room.
- Upgrading of security fencing and guardhouse; fire fighting facilities; refuelling capability commensurate with anticipated aviation traffic, if necessary.

Upgrades to the Gobe Airfield, if required, will be undertaken within the footprint of the existing facility.

Helipads

Hides Helipad. Medical evacuations and regular field operations (including personnel transport) during construction and operations require a helipad at Hides, with refuelling and workshop.

Hides Wellpad D Helipad. Hides Wellpad D will have accommodation for drilling personnel on Hides Ridge. A helipad for emergency medical evacuations is planned to be established at the closest wellpads to the wellpad being drilled. The location will be changed to suit the drilling program.

Juha Helipad. The Juha Production Facility will require a helipad for emergency medical evacuations during construction and operations.

Kopi Helipad. The existing helipads at Kopi, with hangar and refueling facilities, will be available for medical evacuations and personnel transport.

Mainline Valve Stations. Provision is made for helicopter access to mainline valve stations and cathode protection stations by means of a helipad at each station.

Helipad locations are shown on Figure 5.4.

5.2.3 Access via Land

Roadways and associated bridges will be required to haul pipe, materials, fuel, equipment, transportable accommodation and other materials and supplies, and also to bus construction workers to and from work.

Figure 5.5 shows a map of existing public roads, new project roads (i.e., for project use only with no public access), existing controlled-access roads and new or upgraded bridges in the upstream project area.

The road upgrades and realignments at the LNG Facilities site are described in Sections 4.2.1.5, Public Road Upgrade from Port Moresby to the LNG Facilities Site and 4.1.2.6, Rerouted Public Road.

Figure

5.4 Construction camps, laydown areas and helipads

Figure

5.5 Roads, access tracks and bridges (upstream)

5.2.3.1 Roadway Design Criteria

Table 5.2 defines the terminology used with regard to the roadways that will be used for the logistics routes and other project-related roadways. 'Roadway' is the generic term used in this EIS to refer to any type of road or access track.

Table 5.2 Roadway and bridge terminology

Term	Definition
Project roads	New project-specific and project-use-only roadways to complete the maximum 16% grade logistical corridors to the Hides and Juha sites and the airfields.
Public roads	Existing roadways whose access is not controlled or limited to private or exclusive use by the PNG LNG Project or other operators in the region. Generally designed to 'Medium Rural Class 2' standards (PNG Department of Works Road Design Manual). Existing public roads will reopen to unrestricted public use after construction.
Controlled access roads	Existing roadways available for use by the PNG LNG Project, to which access is currently controlled by other operators in the region.
Access tracks	New, project-use-only vehicle access to wellpads.
Shoo-fly roads	Temporary roads to allow construction equipment to bypass the steep areas.
Major bridge	A span of greater than 30 m.

Table 5.3 describes the preliminary design criteria, which will be applied in the following situations:

- Design and construction of new upstream project roads and access tracks.
- Upgrade of existing upstream roadways for project logistics use.
- Upgrade of Lea Lea Road to the LNG Facilities site.
- Design and construction of the Lea Lea Road bypass around the LNG Facilities site.

Table 5.3 Preliminary design criteria for roadways

Parameter	Preliminary Design Criteria for Project Roads	Preliminary Design Criteria for Access Tracks
Design speed	70 kph (desirable) in flat and rolling terrain, less than 10° side slope	25 kph
	50 kph in hilly terrain, 10° to 30° side slope	
	25 kph in mountainous terrain and greater than 30° side slope	
Horizontal curve radius (minimum), road only	27 m	27 m
Curve widening (6.5 m nominal pavement-width road)	R27* to R60, 1.2 m	Not required
	R61 to R90, 0.9 m	
	R91 to R120, 0.6 m	
	Greater than R121, 0 m	
Vertical Grades		
Design intent	0% to 14%	0% to 16%
Maximum	16%	16%
Minimum grades in box cut	0.5% (for drainage)	0.5% (for drainage)

Table 5.3 Preliminary design criteria for roadways (cont'd)

Parameter	Preliminary Design Criteria for Project Roads	Preliminary Design Criteria for Access Tracks
Road Width		
Pavement minimum	6.5 m	4 m
Formation minimum	8 m	5.5 m
Cross-fall on pavement and shoulders	4%	4%
Batter Slopes		
Cut slopes:		
• Limestone	0.25H:1V to 0.5H:1V	0.25H:1V to 0.5H:1V
	Bench height, 10 m max	Bench height, 10 m maximum
	Bench width, 2 m min	Bench width, 2 m minimum
• Volcanic soils	1H:1V to 4H:1V (subject to seismicity and geotechnical confirmation)	1H:1V to 4H:1V (subject to seismicity and geotechnical confirmation).
	Bench height, 6 m max	Bench height, 6 m maximum
	Cut height, 15 m max	Cut height, 15 m maximum
	Bench width, 3 m min	Bench width, 3 m minimum
Fill slopes:		
• Heights 0.5 m or less.	4H:1V	1.5H:1V
• Heights greater than 0.5 m.	1.5H:1V	1.5H:1V
Pavement depth (indicative only):	Rock subgrade: 300 mm Clay subgrade: 500 mm	200 mm 200 mm
Design loading:		
• Standard loading	AS 5100.2 (2004) T44	Not applicable T44
Guard rails	Generally excluded except high-risk locations and near exposed pipelines	Generally excluded except in locations of high risk

*R = radius of curvature.

The main upgrades to existing roads in the upstream project area are planned to involve 200 mm of limestone topping to improve durability under increased traffic loads, strengthening of bridges and increasing the radius of sharp curves to allow large or heavy loads. The maximum grade for the logistical route will be limited to 16%.

All new or upgraded bridge construction will be in accordance with AS 5100, the Australian Standard for Bridge Design code (Attachment 3, Technical Codes and Standards).

Plates 5.1 and 5.2 provide examples of a typical large and small bridge respectively on the Highlands Highway.

Culverts will be designed to accommodate design flows and mitigate sedimentation and debris.

Plate

Where practicable, new roadways will be routed to avoid erosion-prone areas, such as weak soils, tributary headwalls along ridges and over-steepened slopes in gorges. Management and mitigation measures specific to erosion and sediment control are outlined in Section 18.2.2.1, Construction.

Suitable speed limits will be established along the roadways (and the ROW) during construction.

5.2.3.2 Upstream Roadways: Overview

Construction for the PNG LNG Project will require the use and upgrade of existing public and project roads (see Figure 5.5). The two main overland routes within the upstream project area will be the northern logistics route (Highlands Highway) and the southern logistics route (a combination of public, controlled access and project roads). Both the northern logistics route and the southern logistics route will incorporate the ring road between Moro–Tari–Hides and both routes will be used to spread the impact of the project over the two main ports into Papua New Guinea.

Expected truck movements during Phase 1 construction is shown in Table 5.4.

Table 5.4 Truck movements during upstream construction

	No. Truckloads Northern Route	No. Truckloads Southern Route
Early Works	527	468
Hides Gas Conditioning Plant	1,182	
Upstream Infrastructure	901	722
Drilling	905	
Total	**3,515**	**1,190**

Northern Logistics Route

The Highlands Highway (Plate 5.3) provides two-lane vehicle access from Lae to Poroma (see Figure 5.1). In general, it comprises five road sections: Lae to Mount Hagen, Mount Hagen to Poroma, Poroma to Tari, Tari to Idauwi, and Idauwi to the Hides Gas Conditioning Plant. The current transport load envelope for this route is 18 m long by 4 m wide by 4.4 m high, and loads are limited due to existing bridges. Road conditions are highly variable but the road is generally trafficable for normal trucks up to 44 t GVM[1] (T44 bridge loading). Its primary project purpose will be to carry freight from the port at Lae for early works of the Hides Gas Conditioning Plant and for drilling, provisionally as follows:

- Early Works – approximately 23,900 freight tonnes and 600 truck loads.
  - Camps: 15,000 freight tonnes.
  - Construction equipment: 3,600 freight tonnes.

[1] GVM=Gross Vehicle Mass.

  - Catering: 1,500 freight tonnes.
  - Fuel: 3,800 freight tonnes.

- Hides Gas Conditioning Plant construction – approximately 61,700 freight tonnes and 1,500 truck loads.
  - Camps: 17,000 freight tonnes.
  - Construction equipment: 3,900 freight tonnes.
  - Catering: 4,000 freight tonnes.
  - Fuel: 7,900 freight tonnes.
  - Mechanical/electrical bulks: 28,900 freight tonnes.

- Drilling – approximately 40,800 freight tonnes and 1,020 truck loads.
  - Catering: 2,100 freight tonnes.
  - Fuel: 13,700 freight tonnes.
  - Rig equipment: 25,000 freight tonnes.

Trucks are planned to travel the Highlands Highway in convoy and take approximately three days to travel from Lae to Hides. Up to 66,000 freight tonnes of line pipe, and about 3,000 truckloads may also be transported from Lae. The northern logistics route will be in use from one month after contract award for preliminary pioneer construction for the duration of the construction of Phase 1 of the project. Mobilisation of the construction spreads for the Hides Gas Conditioning Plant and for the pipeline ROW will begin approximately 5 months after contract award. Mobilisation of pipeline construction spreads will begin approximately 5 months after contract award. Line pipe will be transported before mobilisation and stockpiled at laydown facilities located at the Hides Gas Conditioning Plant, at two sites between the Hides Gas Conditioning Plant and Homa, and at Homa, Moro and Kutubu. The northern logistics route will also function as a back-up for the Hides Gas Conditioning Plant heavy and oversized loads.

Southern Logistics Route

The southern logistics route will usually follow the existing crude oil export pipeline roadway between Kopi and Moro. Upgrading or new construction will be needed in some sections (see Section 5.3.4, Roadways and Bridges). More specifically, the route comprises five road sections, from Kopi to Moro Junction, Moro Junction to Poroma, Poroma to Tari, Tari to Idauwi, and Idauwi to the Hides Gas Conditioning Plant.

The southern logistics route will primarily be reserved for freight associated with pipeline construction plus approximately two thirds of the early works freight, provisionally as follows:

- Pipeline construction – approximately 370,600 freight tonnes (210 barge loads from Port Moresby and 722 truckloads to laydown areas):
  - Camps: 17,000 freight tonnes.
  - Construction equipment: 67,800 freight tonnes.
  - Catering: 12,600 freight tonnes.
  - Fuel: 40,000 freight tonnes.
  - Bridges: 10,000 freight tonnes.
  - Onshore line pipe: 223,800 freight tonnes (approximately 10,000 truck loads). Pipe may be delivered via Port Moresby or direct to Paia Inlet and barged to Kopi as carried out on earlier oil pipeline projects.

- 'Early works' – approximately 47,000 freight tonnes (47 barge loads from Port Moresby and 940 truckloads to laydown areas along the route):
  - Camps: 14,000 freight tonnes.
  - Construction equipment: 18,000 freight tonnes.
  - Catering: 2,000 freight tonnes.
  - Fuel: 10,000 freight tonnes.
  - Bridges: 2,800 freight tonnes.

Some of this freight will arrive by barge from Port Moresby. The balance might be shipped directly to a location in the Gulf of Papua near Kopi such as Paia Inlet, then lightered directly ashore from the ship.

From the Port Moresby laydown areas, freight will be moved by coastal barge to Kopi, where it will be unloaded and stored at the Kopi laydown area. Mobilisation of freight from Kopi will be by truck up the southern logistics route between Kopi and Moro to a series of additional laydown facilities at Kikori, Gobe, Kantobo, Manu, Kutubu and Moro (see Figure 5.1).

The southern logistics route is expected to be in use from one month after contract award to mobilise equipment and supplies for early works. Pipelaying freight would most likely begin eight months after contract award, beginning with equipment and supplies associated with ROW construction and line pipe for stockpiling and laying as the ROW progresses. Mobilisation of the pipeline spreads will most likely begin 12 months after contract award and will involve the movement of equipment and supplies necessary to lay the pipe. The southern logistics route is expected to be required for 45 months after contract award, but not thereafter.

Some of the equipment for the Hides Gas Conditioning Plant is large and includes generators, compressors and vessels. These cargo loads are called 'heavy logistics movements'. The current base case is that the Hides Gas Conditioning Plant may require approximately 35 large heavy logistic movements. These heavy and oversized loads (see Table 5.1), would each result in a gross vehicle mass of approximately 73 tonnes on a trailer, which is too heavy for routine transport on even the upgraded Highlands Highway. The base case is to transport via the southern logistics route from Kopi to Hides[2]. These heavy logistic movements move at very slow pace, especially on steeper slopes. It is common practice in construction to move such heavy construction loads at night to avoid disruption to public traffic. Mitigation measures that will control these heavy movements will be detailed in the project road and traffic management plan.

The southern logistics route will also back up the Highlands Highway for drilling and Hides Gas Conditioning Plant normal loads.

Ring Road

A section of rural road from Poroma to Moro was opened after the Kutubu Petroleum Development Project was completed and currently supports all operations in the Kutubu and Hides areas. The ring road will be used by both southern and northern logistic routes.

[2] These heavy and oversized loads may be air lifted into Komo Airfield (see Figure 5.1) by cargo aircraft, usually from Port Moresby, where they will arrive by ship and be transported by truck to Jacksons International Airport.

5.2.3.3 Upstream Roadways: Construction and Upgrading

The upstream roadways that will be constructed or upgraded are summarised in Table 5.5. (The table excludes temporary construction access that may be required to facilitate pipeline construction such as shoo-flies and access tracks.) Figure 5.5 shows the upstream roads and bridges that will most likely be upgraded for the project.

Table 5.5 Preliminary summary of proposed new and upgraded roadways

No.	Segment Name	Segment Contains	Approximate Length (km)
Northern Logistics Route			
1	Highlands Highway from Lae to Poroma turnoff*	Public road	604 km, of which 25 km will require upgrading between Mendi and Poroma
Southern Logistics Route			
2	Kopi to Samberigi turnoff	Public road	77
3	Samberigi turnoff to Gobe Airfield turnoff	Project road	25
4	Gobe Airfield turnoff to Gobe Production Facility	Project road	10
5	Gobe Airfield turnoff to Kantobo	Project road	29
6	Kantobo to Moro ring road turnoff	Project road	85
Ring Road			
7	Moro ring road turnoff to Poroma	Public road	97
8	Poroma to Mendi	Public road	25
9	Poroma to Idauwi	Public road	139
10	Idauwi to Hides Gas Conditioning Plant turnoff	Public road	21
Hides to Komo			
11	Hides Gas Conditioning Plant turnoff to Juha turnoff	Public road	2
12	Hides Gas Conditioning Plant turnoff to Komo	Public road	17
Future Logistics Access to Juha Production Facility			
13	Juha turnoff to Juha Production Facility	Project road	57
Additional Non-logistics Roads			
Access to Angore Wellpads			
14	Idauwi to Dagia River	Project road	6
15	Dagia River to Angore Wellpad A turnoff	Access track	10
16	Angore Wellpad Access (A and B)	Access track	1 and 0.1
Access to Hides Ridge			
17	Juha Turnoff to Hides Wellpad G	Access track	21

Table 5.5 Preliminary summary of proposed new and upgraded roadways

No.	Segment Name	Segment Contains	Approximate Length (km)
Additional Non-logistics Roads (cont'd)			
Access to Juha Wellpads			
18	Juha Production Facility to Juha Wellpad A	Access track	1
19	Juha Production Facility to Juha Wellpads B and C	Access track	8
Access to South East Hedinia Wellpads			
20	Pipeline intersection from Kutubu Road to South East Hedinia Wellpads A and B**	Access track	4

* From Poroma turnoff, the Northern Logistics Route connects with the ring road to the Hides Gas Conditioning Plant.

** For South East Hedinia, a new access track approximately 4 km long is required to connect to the existing crude oil export pipeline ROW to the Kutubu Central Processing Facility.

*** Existing track has not been gazetted but is used by the public.

In order to carry the heavy and shock-sensitive loads delivered by aircraft, what is effectively a new road will be constructed between Komo Airfield and the Hides Gas Conditioning Plant.

5.2.4 Accommodation, Laydown Areas and Fuel Depots

Table 5.6 lists the proposed locations and estimated land access and acquisition areas for accommodation, laydown areas (see Figure 5.4) and fuel depots.

Table 5.6 Proposed construction camps, laydown areas and fuel depots

Location*	Camp	Laydown Areas	Fuel Depot	Maximum Occupancy
Hides Gas Conditioning Plant	Y	Y	Y	200
Komo Airfield	N	N	Y^	N/A
Idauwi**	Y	Y	Y	500
Dagia	Y	Y	Y	700
Homa	Y	N	Y	200
Moro / Homa	N	Y	N	N/A
Moro / Ridge	Y	Y	Y	700
Arakubi	Y	N	Y	300
Tamadigi	Y	Y	Y	700
Mubi River	Pioneer	N	Y	300
Gobe Airfield	Y	Y	Y	700
Kikori River	Y	Y	Y	700
Kopi Shore Base	Y~	Y	Y	980
Kopi bypass#	Y	Y	Y	200

*The use of existing camps, such as Nogoli and Kobalu, will be investigated during FEED.

^Aviation fuel tankage and distribution system.

~Pioneer camps are proposed initially at these sites.

**A decision on logistics at Idauwi will be determined during detailed design.

#See Section 6.2.3.2, Kikori River Crossing to Omati River Landfall.

5.2.4.1 Accommodation Facilities

During construction, PNG LNG Project workers will be accommodated in camps. Drilling and pipeline construction camps will be located at various sites and some of them will be relocatable.

Each camp, which will provide sleeping, feeding and abluting facilities, will be self-sufficient for electrical power, communications, potable water, wastewater treatment and domestic incinerator. All wastes generated by the camps will be managed and disposed of in compliance with the project's waste management plan (see Chapter 25, Waste Management). Water supply will be drawn from local streams in accordance with the relevant environment (water extraction) permit and treated by a package plant to potable standards.

Upstream Onshore Construction Camps

In accordance with ExxonMobil's land use standard (see Section 3.3.1, Pipeline Routing Standards), these construction camps will use the sites of previous construction camps established for the Kutubu and Gobe projects where practicable, with new camps at Hides (and at Juha during Phase 4). There might be one or two moveable construction base camps for each pipeline spread, which most likely will be occupied sequentially by first the road and bridge construction crews and then the pipeline crews. Each base camp will support construction activities for a distance of approximately 60 to 80 km.

Smaller camps may be required along the ROW for special crossings, for example, to support horizontal directional drilling across a large watercourse. Camps will be located as close as possible to the pipeline ROW. Construction camp locations are shown in Figure 5.4.

Onshore construction camps will have a minimum of 100 personnel at any one time and a maximum of 1,200, and there could be up to five camps operating at any one time. There will be one camp for each construction spread. Section 1.2.6, Project Staffing, summarises project workforce numbers for the whole project during construction and operations.

All onshore construction camps will be sited to limit environmental impacts. After construction is completed, the camp site will be returned to its natural contours and grade, and topsoil will be returned to the areas from which it was removed. Site preparation and cleanup activities that apply to all project facilities and infrastructure development are described in Section 2.4, Common Construction Activities.

Hides Construction Camp. A temporary construction camp at the Hides Gas Conditioning Plant will be established on site to house approximately 1,200 to 1,500 construction workers and project management team members. The following will be included at the camp:

- Temporary utilities.
- Waste handling, treatment and disposal.
- Catering and janitorial services.
- Medical, security and community affairs facilities.
- Accommodation, offices and recreational facilities.
- Material storage, fabrication, preparation and maintenance facilities.
- Transportation.

Road Construction Camps. It will be necessary to establish camps to support the logistics road construction. For example along the ring road, five camps of 6.5 ha each (to accommodate

approximately 200 people at each camp) will be established to support road and existing bridge upgrade construction. Also, three bridges along the Highlands Highway have been identified as requiring upgrades. Therefore three camps of 3.0 ha each (to accommodate approximately 80 people at each camp) will also be required.

At each existing bridge site, it will be necessary to establish a small laydown construction area.

5.2.4.2 Laydown Areas

In addition to Port Moresby, Lae and Kopi Shore Base, laydown areas during construction will be provided at nine other locations upstream as listed in Table 5.6 (see Figure 5.1).

5.2.4.3 Fuel Depots

Fuel depots will store and dispense fuel for use during project construction and will be in containment bunds to contain the entire contents of the enclosed tanks or bladders.

For upstream construction, the main fuel depot will be situated at Kopi Shore Base with secondary depots at Gobe Airfield and Hides, and smaller depots at Moro, Homa and Idauwi. Fuel will be delivered from Kopi Shore Base to the other fuel depots in 20,000-L-capacity tanker trucks. Fuel will be supplied to the fuel depots either directly from the mini-refinery at Kutubu or from imports via the main upstream fuel depot at Kopi Shore Base.

Fuel consumption for upstream construction is expected to be in the order of 130,000 L per day, which equates to seven 20,000-L-tanker deliveries per day. A 21-day-supply reserve will require 2.73 ML of storage capacity shared across the fuel depots.

All fuel tanker trucks will carry a spill kit, and those carrying Jet A1 fuel will carry a fuel spill response kit and oil spill response procedures.

Mitigation measures for management of fuel and chemical spills in relation to potential impacts on soils and water resources are described in ‘Soil Contamination Mitigation’ in Section 18.2.2.1, Construction, and ‘Water Quality’ in Section 18.3.2.2, Operations.

5.2.4.4 Quarries

Rock and borrow material will be required to upgrade or construct the roadways and will generally be available from existing quarries used for oil pipeline construction. New quarry sites have been identified and those excavated outside the ROW are not likely to be larger than 1.5 ha in area and will be approved by the landowners prior to their use by the project. Quarry locations are provided in Figure 5.6.

Common site preparation and cleanup and rehabilitation measures described in Section 2.4, Common Construction Activities, will also apply to quarry developments. In particular, preconstruction surveys will focus on potential for caves with bat roosts or cultural remains that are commonly found in limestone karst terrain where the quarries will likely be developed.

Figure

5.6 Quarries

Road base and foundation aggregate material sourced from in country quarries not developed by the project will be in accordance with the requirements of Land and Community Affairs guidelines and procedures, that provides controls for the amount of gravel extracted from quarries.

Grade rock will also be required to be crushed and screened for use as concrete or road surfacing aggregate. An existing quarry near Kutubu will provide these requirements. Quarry sites may be required in the Hides area as the existing Hides quarry cannot provide material of the required grade. Where practicable, no quarries will be established beyond cut at Hides Ridge.

Proposed mitigation and management measures to limit the impact of quarrying are detailed in Section 18.7, Biodiversity.

5.2.4.5 Equipment Maintenance Facilities

Service trucks will provide daily and routine fleet maintenance at each upstream work location. Small service facilities at each construction camp will provide intermediate service for the fleet and light vehicles. Major service and repair work will be carried out in a new dedicated facility to be constructed in the vicinity of Moro Airfield.

5.2.4.6 Vehicle Washdown Stations

Vehicle washdown stations are planned to be constructed at Kopi, Moro, and at the Hides Gas Conditioning Plant, with closed cycle filtration water systems to protect local biodiversity. More specifically, this will involve establishment of chemical washdown points at or near the Hides Gas Conditioning Plant to prevent soils, weeds and pathogens being transported to and within Hides Ridge and Juha for the life of the project. Water will be filtered prior to release, and washed material will be disposed of appropriately in accordance with the relevant environment (waste discharge) permit.

Proposed mitigation and management measures to control the disposal of washdown waters are described in Section 18.7, Biodiversity.

5.2.4.7 Offices

The main project construction offices will most likely be located at Kutubu, Kopi and Hides. Site offices will be incorporated into the construction camps.

5.3 Constructing or Upgrading the Logistics Infrastructure

5.3.1 General

The logistics infrastructure will be generally established by conventional civil engineering construction methods.

5.3.2 Kopi Wharf

The new wharf at Kopi will be constructed of steel and reinforced plain materials.

5.3.3 Upstream Pioneer and Construction Camps and Laydown Areas

Sites for the construction camps will be prepared as described in Section 2.4, Common Construction Activities, except those construction camp sites used by earlier projects, which may only require cleaning and upgrading. The total area for camp platforms will exceed 100 ha (see Table 5.6), and approximately 250,000 m^3 of cut and fill will be needed for platform formation.

For maximum flexibility in camp capacities, modular truck-transportable units will most likely be used where practicable; however, pioneer camps may use tents. Camp units will include:

- Office, living quarter, sanitary block, kitchen and laundry container-type units (6 or 12 m in length).
- Mess hall and medical centre shelter-type units (metallic structures with insulated panels and wooden floors).

Camp units will be delivered to site by truck and placed on concrete block foundations by crane. Services (electricity, water and sewage) will then be connected.

5.3.4 Roadways and Bridges

The upstream roadways and bridges will be constructed or upgraded in a logical sequence to avoid delaying the facilities construction crews and pipelaying spreads. At some locations, 'pioneer crews' will be used to construct bridges, roadway clearing, camp sites and other special construction activities sometimes in advance of the main spread to enable uninterrupted work by the main spread.

Generally two different approaches will be taken at existing bridge sites. Either a temporary crossing will be provided adjacent to the existing bridge while upgrades are taking place, or a new bridge will be located adjacent to the existing bridge so the existing bridge can remain in use during construction. For either option, an area will be disturbed one side of the bridge location, up to 200 to 300 m from the existing bridge location.

Three earthworks spreads will most likely be deployed to upgrade the access ways, roadways and bridges. Each earthworks spread will be complemented by a bridge installation crew working in conjunction with, but either ahead of, or behind, the earthworks crews, depending on the area.

One earthworks spread will most likely be mobilised for early works via the existing Kopi roll-on, roll-off ramp, to complete the Gobe to Mubi River roadway reinstatement, the Mubi River to Kantobo new roadway, three major bridges and pioneer camp sites at Kopi, Gobe and Mubi River.

The second earthworks spread will most likely mobilise directly to the Hides area. Initial mobilisation will be a pioneer crew to establish a pioneer camp at Hides, which will be developed into a construction camp to support full mobilisation at the Hides site and to support the earthworks spread in that vicinity. Potential use of the existing Nogoli or Kobalu camps will be investigated during FEED and detailed design.

The third earthworks spread will enter via Kopi and proceed directly to the Homa to Dagia River area to work that section in conjunction with the spread mobilised during early works.

Construction of the roadways and bridges after initial earthworks will include:

- Installing culverts.
- Delivery of geotextile material by truck.
- Laying geotextile material on the roadways.
- Delivery of limestone from the project quarries by truck.
- Dumping and spreading limestone material over the roadway surfaces.
- Delivery of rock (if required) for abutment or gabion construction.
- Constructing bridge abutments, gabions and concrete footings.
- Delivery of the prefabricated bridge spans by truck.
- Placing the bridge spans on the abutments and concrete footings using cranes and incremental launching and securing the spans in place.

Rock, some of which will require blasting, is estimated to occur along approximately one third of the alignments. Where blasting is required, drilling equipment may be used to prepare blast holes, and rockbreakers may be used for secondary breaking of large rocks. A blasting management plan will be developed considering ANZECC guidelines and in consultation with local communities (see Section 18.9.3.1, Construction). In addition blasting will be controlled (where practicable) within 100 m of known colonies of bat caves identified during preconstruction surveys (see Section 18.7.3, Mitigation and Management Measures).

The thickness of limestone placed on the geotextile fabric will most likely be greater than 150 mm.

Prefabricated panel truss bridge of the Bailey types will be the project bridge design standard.

The main divisions in the work program are discussed in the following section from the pipeline landfall in the southeast to the production wells in the northwest.

5.3.4.1 Kopi to Gobe Airfield Turnoff

This section of road between Kopi and the Gobe Airfield turnoff is approximately 102 km in length. There is also an additional section of approximately 10 km, which leads from the Gobe Airfield Turnoff to the Gobe Production Facility. These roads are existing; however, they will most likely require upgrading for the southern logistics route.

Roadway construction material will be supplied from the existing quarry located near Kopi, other approved quarries or quarried from limestone pinnacles located along the route. Material imported from outside swamp forest areas will remain after construction. Seasonal flooding is common and so culverts will be placed as necessary in minor creeks and streams to allow the normal cross-flow of water where required. Post rehabilitation monitoring of vegetation will be undertaken in swamp areas to establish if additional remediation is necessary to maintain hydraulic flows in the area of project works.

The early works bridge crew is expected to construct a new major bridge over the Kikori River. Also, there are 17 existing bridges between Kopi and the Gobe Airfield turnoff, some of which may need to be upgraded.

5.3.4.2 Gobe Airfield Turnoff to Kantobo

Nineteen kilometres of this 29-km section will follow much of the crude oil export pipeline ROW. The remaining 10 km is expected to require a new separate project road, which will bypass to the

west the existing ROW construction using lower terrain around the elevation climb from Mubi River, rejoining ROW near Kantobo village.

Work will include clearing, widening, and improvement of the existing ROW to provide an 8-m-wide roadway. Two new bridges (one of which will cross the Mubi River) and numerous culverts will be installed. The route is largely lowlands, subject to seasonal flooding and does not require extensive excavation.

The most extensive excavation of this initial spread will be for a pioneer camp on the north side of the Mubi River. This site will most likely be accessed via shallow-draft landing craft-type vessels prior to construction of the new bridge across the Mubi River.

5.3.4.3 Kantobo to Moro Ring Road Turnoff

This 85 km section in karst terrain follows an alignment that is currently trafficable by construction vehicles. Where needed, the roadway will be upgraded to project standards (see Table 5.3). Oil Search Limited controls access to the road in this area. The grading crew will clear the existing ROW of vegetation (mainly regrowth since the completion of the crude oil export pipeline) and prepare a road surface within the ROW for use as the logistics route where required. This may involve the profiling of watercourse crossings and the benching of side cuts.

There are two bridges in this section that might require upgrades.

5.3.4.4 Moro Ring Road Turnoff to Poroma

Work envisaged for this 97-km section consists of road upgrades and six bridges that might require upgrades.

5.3.4.5 Poroma to Idauwi

The section of road from Poroma to Idauwi is approximately 139 km long and is an existing public road that might require upgrading. Fifteen bridges might also need upgrading. The road from Poroma to Mendi (approximately 25 km in length) will require upgrading. A bridge in this road segment might also need upgrading.

5.3.4.6 Idauwi to Hides Gas Conditioning Plant Turnoff

The section of road between Idauwi and the Hides Gas Conditioning Plant turnoff is approximately 21 km long. There is an existing road that will need upgrading.

There are three bridges along this section currently planned to be replaced.

5.3.4.7 Hides Gas Conditioning Plant Turnoff to Komo

This 17-km long section is located in gentle terrain. The existing road will require upgrading.

There is one bridge along this section not currently planned to be upgraded.

5.4 Environmental Safeguards

The functional efficiency priorities included in constructing and operating the logistics infrastructure are subject to the requirements of:

- Public safety and interference.
- Public access to project roads.
- Management of runoff water and sediment.

Roads and traffic mitigation measures will be the subject of a specific environmental management plan (see Section 30.3.1, Project Environmental Management Plan) and the process for developing this and other plans is set out in Chapter 30, Environmental Management, Monitoring and Reporting.

The ExxonMobil Engineering Practices Systems will serve as the basis for project design specifications (see Section 2.1, Introduction).

5.5 Decommissioning the Logistics Infrastructure

All logistical infrastructure not required for operational purposes may be dismantled and removed for sale, recycling or disposal or may be retained by the PNG or provincial governments as public assets. In addition, all new project roads constructed between Kopi and the Hides Gas Conditioning Plant will not be maintained following completion of construction works of all phases of the project.