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Environmental Impact Statement  
PNG LNG Project

## **30. ENVIRONMENTAL MANAGEMENT, MONITORING AND REPORTING**

### **30.1 Introduction**

This chapter outlines the framework for environmental management, monitoring and reporting for the Papua New Guinea Liquefied Natural Gas Project (PNG LNG Project). It provides an overview of the environmental management system under which the project will be constructed and operated (Section 30.2), describes the range of management plans for environmental, social and, health and safety (Section 30.3), the organisational structure and reporting (Section 30.4), the policy, legislation, guidelines and standards (Section 30.5), and monitoring and reporting (Section 30.6).

### **30.2 Environmental Management System Overview**

Early works, construction and operations of the PNG LNG Project will be managed under ExxonMobil's environmental management system, which was prepared under the auspices of the ExxonMobil Environment Policy (see Figure 1.5).

#### **30.2.1 Operations Integrity Management System**

The environmental and socio-economic management of the PNG LNG Project during construction and operations will be in accordance with relevant elements of ExxonMobil's Operations Integrity Management System (OIMS) (ExxonMobil, 2004). In particular, the environmental management plans for the PNG LNG Project will be prepared and implemented in accordance with the OIMS. The OIMS is consistent with the principles of AS/NZS ISO 14001, the international standard for environmental management systems.

The key elements of the OIMS are:

- Management, leadership, commitment and accountability. Employees at all levels are held accountable for safety, health and environmental performance.
- Risk assessment and management. Systematic reviews evaluate risks to help prevent accidents from happening.
- Facilities design and construction. All construction projects from small improvements to major new expansions are evaluated early in their design for safety, health and environmental impact.
- Information and documentation. Information that is accurate, complete and accessible is essential to safe and reliable operations.
- Personnel and training. Meeting high standards of performance requires that employees are well trained.
- Operations and maintenance. Operations and maintenance procedures are frequently assessed and modified to improve safety and environmental performance.

- Management of change. Any change in procedure is tested for safety, health and environmental impact.
- Third-party services. Contractors are important to safe operations.
- Incident investigation and analysis. Any incident, including a 'near miss,' is investigated.
- Community awareness and emergency preparedness. Good preparation can significantly reduce the impact of an accident.
- Operations integrity assessment and improvement. A process that measures performance relative to expectations is essential to improved operations integrity.

### **30.3 Management Plan Framework**

Management plans are an intermediate step between the general requirements and commitments defined by corporate policy and the regulators, and the specific tasks for project staff and contractors defined in individual work procedures. They may be an all-encompassing 'environmental management plan' or, as is the case here, part of a range of more specific plans covering topics that include environment, occupational health and safety, cultural heritage and social matters.

#### **30.3.1 Environmental Management Plans**

As shown in Figure 30.1, each facility will have an operations environmental management plan developed in accordance with the project environmental management plan. These plans will be closely related to, and will interlink with, those prepared for early works and construction described in Section 30.3.1.1, Construction Environmental Management Plan. Where the environmental management plan has a large scope of work – such as the water management plan – there will be a series of discrete sub-plans to address each topic of the plan, such as surface water, groundwater and erosion control. The current structure is shown below and it is expected that this will evolve as the findings of the environmental management system audits are implemented.

##### **30.3.1.1 Project Environmental Management Plan**

The project environmental management plan will be a compendium of interrelated environmental management plans that will evolve over the life of the project as the project moves from construction and operations through to subsequent stages (see Section 1.2.1, Project Description). The plans anticipated to be generated throughout the life of the project and their hierarchies are provided in Figure 30.1 and Figure 30.2.

The project environmental management plan will capture the EIS commitments and any conditions of approval stipulated by the PNG Government, as well as the potential requirements of lending institutions associated with the project. It will also define the framework that contractors will be required to follow when preparing their more detailed construction and operations environmental management plans. Contractors working on the project will be contractually obligated to comply with the environmental requirements, specifications and procedures set out in the project environmental management plan, as applicable to their specific scope of works.

Figure

**30.1 Preliminary management plan framework**

Figure

**30.2 Indicative operations management plan hierarchy**

The environmental management plans will include the following components:

- Identified issues and impacts.
- Performance targets.
- Mitigation and management measures.
- Monitoring requirements and activities.
- Implementation schedules.
- Responsibilities and lines of communication.

In addition to industry good practice procedures, the early work, construction and operation environmental management plans will address the specific and unique environmental issues associated with the PNG LNG Project identified during the EIS program.

### **30.3.1.2 Construction Environmental Management Plan**

For construction, the following environmental management plans are envisaged:

- Air emissions management plan.
- Brush/forest fire management plan.
- Cultural heritage management plan.
- Dredge management plan.
- Ecology, natural habitat and biodiversity management plan. This plan includes the following sub-plans:
  - *Nothofagus* forest management.
  - Pandanus swamp forest management.
  - Project-wide quarantine management.
  - Weeds, pests and pathogens management.
- Hazardous materials management plan.
- Marine fauna observation plan.
- Noise management plan with a blasting management sub-plan.
- Reclamation plan.
- Soil contamination management plan.
- Spill response plan.
- Traffic management plan.
- Use of renewable resources plan.
- Waste management plan.
- Water management plan. This plan includes the following sub-plans:
  - Acid sulfate soil management.
  - Erosion and sediment control management.
  - Hydrotest water management.
  - Surface water and stormwater management.
  - Wastewater management.
  - Watercourse crossing management.
  - Water quality baseline monitoring.

### **30.3.1.3 Operations Environmental Management Plan**

Management plans for the operations stage of the project are envisaged to include:

- Air emissions/greenhouse gas emissions management plan.
- Brush/forest fire management plan.
- Dredge management plan.
- Ecology, natural habitat and biodiversity management plan. This plan includes the following sub-plans:
  - Project-wide quarantine management.
  - Weeds, pests and pathogens management.
- Hazardous materials management plan.
- Noise management plan.
- Soil contamination management plan.
- Spill response plan.
- Traffic management plan.
- Waste management plan.
- Water management plan. This plan includes the following sub-plans:
  - Surface water and stormwater management.
  - Wastewater management.
  - Water quality baseline monitoring.

A decommissioning and closure plan will also be developed; however, it is expected that this will not be submitted to government until near the end of the project life.

### **30.3.1.4 Contractor Environmental Management Plan Guidelines and Expectations**

Each major contractor selected for early works and construction on the project will be contractually obligated to prepare, for the operator's approval, an environmental management plan for the work areas or activities for which they are responsible. Contractor environmental management plans will be required to be developed in accordance with the project environmental management plan and approved by the operator prior to the commencement of works in the field.

#### ***Contractor Environmental Management Plans***

Each contractor environmental management plan will include a compilation of management plans as they pertain to the contractor's activities as listed in Section 30.3.1.1, Project Environmental Management Plan.

#### ***Regulatory Compliance***

Contractors will be responsible for identifying and managing all regulatory compliance issues related to their scopes of work and must prepare a regulatory compliance plan. The plan will include a system for identifying and implementing contractor regulatory requirements, as well as monitoring and reporting.

#### ***Training Responsibilities and Requirements***

In order to ensure that their roles and responsibilities in relation to the contractor environmental management plans are understood, contractors will provide their staff and subcontractors with

appropriate training regarding relevant environmental, social and health issues, and general expectations and requirements.

### **30.3.2 Social Management Plans**

The operator will manage social and cultural aspects of the project. The social and cultural management framework for early works, construction and operations will include a series of sub-plans to address the varied and complex social issues of the project area and communities and are envisaged as follows:

- Compensation plan.
- Consultation and disclosure plan.
- Cultural heritage management plan.
- Employment and training plan.
- Induced access plan.
- National content plan.
- Resettlement action plan.
- Stakeholder engagement management plan.

### **30.3.3 Health, Safety and Security Management Plans**

The operator will manage health and safety aspects of the project. The health and safety framework for early works, construction and operations will include a series of sub-plans to address the varied health and safety issues associated with the project and are envisaged as follows:

- Community health plan.
- Community safety plan.
- Security management plan.
- Worker health plan.
- Worker safety plan.

## **30.4 Organisational Structure and Reporting**

The composition and reporting relationships of the project environmental management plan implementation and monitoring group for the construction and operations stages of the project will be detailed in the project environmental management plan.

### **30.4.1 Overview of the Environmental and Social Management Organisation**

A team of professional staff will form the core of the project's social, security, environment and safety (SSES) organisation. An indicative structure for the project's SSES organisation is shown in Figure 30.3. The SSES organisation will be responsible for developing and implementing the project environmental management plan; communicating expectations and commitments related to environmental and social performance throughout the project organisation and to contractors; and monitoring the early works, construction and operations of all project components.

**30.3 Indicative environmental and social management team organisational chart**

The staffing of the project's SSES organisation will be commensurate with location and work demands. For example, key people will be located on site, while those less directly involved will be located at the PNG administrative office or elsewhere. Implementation is likely to be staged during early works and is anticipated to reach a peak staffing level during the height of construction activities. Similarly, as management needs change over time, the nature of the SSES organisation will evolve to adapt to changed circumstances. Figure

### **30.4.2 Responsibilities**

The project environmental management plan will detail the responsibilities of the SSES organisation, which are anticipated to include:

- Assisting the operator and its contractors with the implementation of the project environmental management plan.
- Monitoring and evaluating the operator's implementation of the project environmental management plan.
- Monitoring defined indicators of the project's environmental impacts.
- Reviewing project plans, designs and strategies in relation to environmental, social and health considerations.
- Maintaining environmental management systems and documentation.
- Preparing and submitting various reports to relevant government agencies and lenders.
- Following up to ensure that non-conformance situations have been successfully addressed by contractors.
- Instituting lessons learned.
- Interfacing with government authorities.

## **30.5 Policy, Legislation, Guidelines and Standards**

The environmental management of the project and the design of facilities and other equipment will be governed by criteria defined in applicable PNG legislation, ExxonMobil policies and guidelines and other standards as may be set. Chapter 8, Legal, Administrative and Planning Framework, describes the legal, administrative and planning framework that will govern the preparation and implementation of the project environmental management plan, including the various potential environmental, health and social standards that will guide management actions during project implementation. Attachment 4, Potentially Applicable Legislation, also lists other PNG legislation and regulations that may apply.

### **30.5.1 Engineering Design and Management Principles**

The engineering design and management principles for the project include adherence to appropriate engineering design codes and standards, such as the ExxonMobil Engineering Practices System, select international engineering standards, and PNG-specific codes and standards. The engineering design codes and standards applicable to the project are provided as Attachment 3, Technical Codes and Standards.

The project has also developed project-specific design philosophies that cover operational practices that overlap with aspects of environmental management, such as equipment and materials handling, facility shutdown, machinery audit, security systems, flare relief and blowdown, loss prevention, and flow assurance. These design codes and standards will be provided to prospective project contractors early in the project design and planning stages to ensure their inclusion in the contractors' designs and work practices.

### **30.5.2 Mitigation Measures**

In addition to the policy, legislation, guidelines, standards and engineering design features discussed above, the PNG LNG Project will implement appropriate environmental and social mitigation measures throughout the construction and operations stages of the project that will be documented in and activated through the project environmental management plan. Proposed environmental and social mitigation measures are described in Chapters 18, Environmental Impacts and Mitigation Measures: Upstream Facilities and Onshore Pipelines; Chapter 19, Environmental Impacts and Mitigation Measures: Offshore Pipeline; Chapter 20, Environmental Impacts and Mitigation Measures: LNG Facilities; Chapter 21, Environmental Impacts and Mitigation Measures: Marine Facilities; Chapter 22, Project-wide Cultural Heritage Impacts and Mitigation Measures; and Chapter 23, Project-wide Socio-economic Impacts and Mitigation Measures as they relate to the assessment of potential impacts. A summary of all of the environmental and social mitigation commitments is given in Chapter 29, Summary of Mitigation and Management Commitments.

## **30.6 Monitoring and Reporting**

Monitoring programs will be developed as the project proceeds into detailed design to take into consideration the requirements of the PNG Government as may arise from the EIS approvals process. The types of parameters to be measured and potential measurement methods are typically stipulated in regulatory permits and licences and may cover topics such as water quality, air quality, noise emissions and blast vibration.

These requirements will be revisited and expanded with specific key performance indicators, monitoring locations and frequencies in the project and contractor environmental management plans. These will be individually tailored for each project component (upstream, offshore and LNG Facilities) and each stage of the project (construction, operations and closure) once the final design and location of the project facilities have been determined.

The project regulatory permits are expected to largely align with, and be informed by, the parameters used to assess the project's compliance with the requirements of the PNG Government and applicable international and other jurisdictions as they relate to discharge of effluents, emissions to air and maintenance of ambient environmental conditions.

The operator and its contractors will establish and maintain a record system to ensure that the environmental management systems are in place and effectively implemented.

## 30.6.1 Monitoring Criteria

### 30.6.1.1 Water Quality

Table 30.1 shows the typical water quality criteria in Schedule 1 of the Environment (Water Quality Criteria) Regulation 2002. It is expected that most water quality criteria will be drawn from this schedule and the emissions criteria shown in Table 30.2. The latter covers emissions, effluent and waste levels for onshore oil and gas developments and includes criteria for ions, pH, hydrocarbons, total suspended solids (TSS), oxygen demand and temperature.

**Table 30.1 Water quality criteria**

Parameters	Fresh Water*	Seawater*
<i>Ammonia-nitrogen</i>	<i>Dependent on pH and temperature</i>	
Arsenic	0.05	0.05
Barium	1.0	1.0
Boron	1.0	2.0
Cadmium	0.01	0.001
Chlorine (total residual)	0.005 at pH 6	0.005
Chromium (hexavalent form)	0.05	0.01
Colour	No alteration to natural colouration ( <i>for both fresh water and seawater</i> )	
Cobalt	Limit of detectability ( <i>for both fresh water and seawater</i> )	
Copper	1.0	0.03
Cyanide (as HCN)	0.005	0.01
Faecal coliform bacteria	≤200 per 100 ml	
Fats	None	None
Fluoride	1.5	1.5
Grease	None	None
Insoluble residues	No insoluble residues or sludge formation to occur ( <i>for both fresh water and seawater</i> )	
Iron (in solution)	1.0	1.0
Lead	0.005	0.004
Manganese (in solution)	0.5	2.0
Mercury	0.0002	0.0002
Nickel	1.0	1.0
Nitrate (as NO <sub>3</sub> <sup>-</sup> + NO <sub>2</sub> <sup>-</sup> )	45.0	45.0
Odour	No alteration to natural odour ( <i>for both fresh water and seawater</i> )	
Oil	None	None
Oxygen	Not less than 6.0	Note less than 5.0
Pesticides	None	None
pH	No alteration to natural pH ( <i>for both fresh water and seawater</i> )	
Phenols	0.002	0.002
Potassium	5.0	450.0
Radioactivity	None	None
Selenium	0.001	0.01
Silver	0.05	0.05

**Table 30.1 Water quality criteria (cont'd)**

Parameters	Fresh Water*	Seawater*
Sulfate (as SO <sub>4</sub> <sup>2-</sup> )	400.0	-
Sulfide (HS <sup>-</sup> )	0.002	0.002
Tars	None	None
Taste	No alteration to natural taste (for both fresh water and seawater)	
Temperature	No alteration greater than 2°C (for both fresh water and seawater)	
Tin	0.5	0.5
Toxicants (miscellaneous)	None	None
Turbidity	No alteration greater than 25 N.T.U (for both fresh water and seawater)	
Zinc	5.0	5.0

\* All values are in mg/L unless otherwise specified. Source: Schedule 1 of the Environment (Water Quality Criteria) Regulation 2002.

**Table 30.2 Emissions, effluent and waste levels from onshore oil and gas development**

Parameter	Guideline Value
Produced water	For discharge to surface waters or to land: <ul style="list-style-type: none"> <li>Total hydrocarbon content: 10 mg/L<sup>#</sup>.</li> <li>pH: 6 to 9.</li> <li>BOD: 25 mg/L.</li> <li>COD: 125 mg/L.</li> <li>TSS: 35 mg/L.</li> <li>Phenols: 0.5 mg/L.</li> <li>Sulfides: 1 mg/L.</li> <li>Heavy metals (total)*: 5 mg/L.</li> <li>Chlorides: 600 mg/l (average), 1200 mg/L (maximum).</li> </ul>
Completion and well workover fluids	For discharge to surface waters or to land: <ul style="list-style-type: none"> <li>Total hydrocarbon content: 10 mg/L<sup>#</sup>.</li> <li>pH: 6 to 9.</li> </ul>
Stormwater drainage	Stormwater runoff should be treated through an oil/water separation system able to achieve oil and grease concentration of 10 mg/L <sup>#</sup> .
Cooling water	The effluent should result in a temperature increase of no more than 3°C at edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 m from point of discharge.

Source: IFC (2007e), which also sets out guidelines for treatment and disposal of drill cuttings, produced sand and water, completion and well workover fluids and hydrotest water.

<sup>#</sup>Project design will work to meet this criterion and will be subject to facilities design optimisation during FEED and detailed design.

\*Heavy metals include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, vanadium, and zinc.

### 30.6.1.2 Air Quality

Table 30.3 shows the air quality criteria used during the air quality assessment. The monitoring requirements will be determined following the PNG Government's assessment of the residual air quality impacts described in this EIS.

**Table 30.3 Air quality criteria**

Substance	Assessment Criteria (Average)	Project Target ( $\mu\text{g}/\text{m}^3$ )
Sulfur dioxide ( $\text{SO}_2$ )	10-minute	500
	24-hour	20
Nitrogen dioxide ( $\text{NO}_2$ )	1-hour	200
	1-year	40
Carbon monoxide ( $\text{CO}$ )	15-minute	100,000
	30-minute	60,000
	1-hour	30,000
	8-hour	10,000
Hydrogen sulfide ( $\text{H}_2\text{S}$ )		No offensive odour at boundary, less than $5 \text{ mg}/\text{m}^3$
Benzene*	1-hour	170
	1-year	4.5
Toluene*	1-hour**	640
	1-year	1,200
Ethylbenzene*	1-hour	2,000
	1-year	200
Xylene*	1-hour	3,700
	1-year	370
p-Xylene*	1-hour	2,080
	1-year	208
$\text{PM}_{10}$	24-hour	150
	1-year	70
$\text{PM}_{2.5}$	24-hour	75
	1-year	35
Total suspended particulates (TSP)	24-hour	150 to 230
	1-year	60 to 90

\* TNRCC uses effects screening levels (ESLs) to evaluate effects of exposure to these compounds in the air. They are not ambient air standards and, if exceeded, do not necessarily indicate a problem but rather trigger more detailed review.

\*\* Note that the 1-hour ESL is less than the annual ESL for toluene. This is because the 1-hour average criteria is based on odour and the annual criterion on toxicity. Meeting the 1-hour goal would ensure no odour or health impacts.

### 30.6.1.3 Noise

Noise levels relevant for assessment of potential impacts for the construction and operation of the project (Appendix 10, Noise Impact Assessment) are as follows:

- Noise criteria at the boundary of facilities (i.e., the LNG Facilities, Hides Gas Conditioning Plant and Juha Production Facility) of 55 dBA  $L_{\text{eq}}$  between 7.00 a.m. and 10.00 p.m. and 45 dBA  $L_{\text{eq}}$  from 10.00 p.m. to 7.00 a.m. for both construction and operations. Criteria are the same for both construction and operations due to the lengthy construction period (see Figure 1.3).
- Single events (e.g., traffic pass-bys on roads) have no daytime criteria suggested but 60 dBA  $L_{\text{max}}$  would be a reasonable design goal. Single events are primarily concerned with

sleep disturbance at night and the night (10.00 p.m. to 7.00 a.m.) noise criterion is 45 dBA  $L_{max}$ .

- Blasting should typically be limited to 115 dB with allowances of a small percentage, up to 120 dB peak, during the day and evening (7.00 a.m. to 10.00 p.m.). Blasting should not occur during the night (10.00 p.m. to 7.00 a.m.), but if it does then it should not be audible to sensitive receptors.

### 30.6.2 Quality Assurance and Control Procedures

ExxonMobil's OIMS (ExxonMobil, 2004) requires periodic assessments of systems, programs and procedures to help ensure continued improvements in performance. Annual reviews of the overall effectiveness of the project's environmental, health and social management strategy will be undertaken to ensure sustainability and effectiveness.

### 30.6.3 Feedback and Improvement

Where environmental, health and social procedures are found to be deficient as a result of routine monitoring, or following an evaluation or investigation after an incident, they will be revised where necessary and the project environmental management plan updated to reflect the new procedures.

### 30.6.4 Further Environmental, Cultural Heritage and Social Studies

A series of studies is under consideration that will guide implementation of baseline monitoring programs for specific aspects of some environmental, social and cultural heritage matters. Table 30.4 is a preliminary list of baseline monitoring studies. Of necessity, these are matters that require the completion of FEED and detailed design, in particular the layout of the components of the various facilities sites, pipeline ROW and access ways. Once the design and facilities locations have been fixed, specific studies such as preclearance surveys and baseline monitoring of the type described in Section 10.1.2, 'Baseline' and 'Monitoring', will be prepared and the findings incorporated into the environmental management, monitoring and reporting of the project.

**Table 30.4 Preliminary list of environmental and cultural heritage studies**

Description	Relevant site(s)
Groundwater supply and abstraction modelling.	Hides Gas Conditioning Plant.
Baseline groundwater surveys for monitoring downstream of engineered landfill sites.	Hides Gas Conditioning Plant and LNG Facilities.
Baseline water quality monitoring and modelling to set mixing zone boundaries for water discharges.	Hides Gas Conditioning Plant, LNG Facilities and pipeline hydrotest water discharge sites.
Preconstruction surveys of hydrology and water quality for construction and operations monitoring.	Hides Gas Conditioning Plant, selected areas of the pipeline ROW (construction only), hydrotest water discharge sites, drilling sites, bridge construction sites and pipeline landfall sites (construction only).
Preconstruction and targeted surveys for notable flora and fauna species and habitats.	Whole of project area.

**Table 30.4 Preliminary list of environmental and cultural heritage studies (cont'd)**

Description	Relevant site(s)
Water abstraction assessments for streams supplying drilling or hydrotesting.	Hides Ridge and other gas fields in later phases of the project, LNG Facilities and pipeline hydrotest water discharge sites.
Cultural heritage preconstruction surveys.	Whole of project area.
Noise and air quality baseline monitoring and modelling of detailed emissions for ongoing construction and operations.	Hides Gas Conditioning Plant, Juha Production Facility (when developed) and LNG Facilities.
Marine biophysical water and sediment surveys.	Marine LNG Facilities.

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