

# Ghana Bridge Power Project

Early Power Limited

Environmental and Social Impact  
Assessment

60K36301

Revision: 4

Date: January 2018

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**Ghana Bridge Power Project**

**Environmental and Social Impact Assessment**

**Volume III: Environmental and Social Management Plan**

**Early Power Limited**

**JACOBS CONSULTANCY PROJECT NO: 60K36301**

Project No.	:	60K36301
Revision	:	3
Revision description	:	ESIA Amendment issued to Ghana Environment Protection Agency, incorporating details of the improved project designs, including where relevant:
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Date	Description of Alteration		Rev No
13 Oct 2015	Draft for EPA review		0
17 Dec 2015	Final version following EPA approval		1
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	<b>Section</b>	<b>Alterations</b>	
	Wherever relevant	Reference to "power plant site" changed to reflect revised plan involving two power plant sites (PPS1 and PPS2).	
	Wherever relevant	Corrections to spelling, grammar and other changes for consistency. Abbreviated terms provided in full at first usage.	
	1.2	Updated project details added.	
	Table 2.1	Updated information, completion of actions and additional measures for: Socio-Economics (prior to construction) – kiosks & farmers Water resources (prior to construction) – application of flood risk measures Air quality (detailed design) – additional modelling / design refinement completed. On-going collaboration with other developers, as well as ambient air monitoring. Noise (design) – slight change to assessment noted.	
	Table 2.2	Updated information, completion of actions and additional measures for: Air quality (operations) – deletion of out of date text and clarification of when vapour recovery would be used. Noise (design and operation) – slight change to assessment noted. Terrestrial ecology (construction) – additional action relating to clearance activities Labour, Workforce, Community Health, Safety and Security: <ul style="list-style-type: none"> <li>• (unsafe working conditions) – additional action in regard to installation of above ground pipeline</li> <li>• (pipeline safety) – clarification of when cathodic protection is used &amp; additional action in regard to installation of above ground pipeline</li> </ul>	

08 August 2017	ESIA amendment issued to Ghana Environment Protection Agency, incorporating details of further project design changes, and associated updates in ESIA findings and mitigation measures, including:		3
	<b>Section</b>	<b>Alterations</b>	
	Wherever relevant	Reference to updated power plant configuration and change in development phasing/staging	
	1.2	Update to project description	
	1.8	Clarification around recent disclosure activities and requirements going forward	
	Table 2-1	Updates to pre-construction / design actions and associated monitoring	
	Table 2-1	Updates to construction and operational mitigation and actions to reflect updated assessments, including: Flood risk – updates to finished levels for site and/or sensitive infrastructure following results of flood risk assessment Air quality – enhanced ambient air quality monitoring regime Noise – addition of requirements for Stage 1a mitigation Climate change – removal of previous mitigation discussion based on updated assessment. Other minor additions as required.	
09 Jan. 18	Table 2.2	Removing reference to Workforce Development Strategy	4

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# 1 Introduction

## 1.1 Overview

This document presents the Environmental and Social Management Plan (ESMP) for the Ghana Bridge Power project ('the project'). The project involves emergency power generation utilising Liquefied Petroleum Gas (LPG) and has been developed to deploy additional electricity as quickly as possible to support the immediate demand for reliable power in the area. The project is being developed and operated by Early Power Limited (EPL). The project includes an onshore power plant (on two plots) and separate LPG storage facilities and the development of a new pipeline infrastructure for supply of LPG and water to the plant.

The ESMP provides the management framework for planning and implementation of monitoring and management activities associated with environmental and social protection, as identified by the Environmental and Social Impact Assessment (ESIA). This ESMP forms Volume III of the ESIA for the Bridge Power project and covers activities throughout the lifetime of the project, from construction through to decommissioning. The ESMP has been prepared in accordance with environmental and social commitments of EPL (the project proponent), and in compliance with the legal and regulatory requirements of Ghana Environmental Protection Agency (EPA) and the World Bank Group (WBG) and International Finance Corporation (IFC) Performance Standards and Environmental, Health and Safety (EHS) Guidelines.

This ESMP will be used as a guide in the development of subsequent detailed management plans for construction, operation and decommissioning phases. An Environmental Management Systems (EMS) team will be appointed for each project phase to develop this framework ESMP. For the operational phase, the ESMP will be developed and expanded into a full EMS accredited or aligned to ISO 140001. ISO 140001 is an internationally accepted standard that outlines how to put an effective environmental management system in place. The recommendations stipulated within this ESMP must be adopted in the development of the detailed EMS' and international IFC standards must be met for the duration of the project.

## 1.2 Project Description

The project includes the development of power plant facilities to provide commercially available power in a series of stages (Stage 1a, Stage 1b, Stage 2), on two sites. Net generation capacities will be 145MW (Stage 1a), 57MW (Stage 1b)<sup>1</sup>, and 222MW for Stage 2, providing a total of 424MW.

Liquefied petroleum gas (LPG) will be used as the primary fuel, though the design allows for operation on diesel fuel oil (DFO) for worst-case scenario operation during a significant disruption to the supply of LPG.

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<sup>1</sup> Guarantee provided by Phase 1 Engineering, Procurement and Construction (EPC) contractor

It is envisaged that within five years from the start of Stage 2 operation, the plant will switch to operation using natural gas (NG) as primary fuel should this be made available by the Government of Ghana (GoG) with LPG becoming the secondary fuel.

The main project components include:

- **Power Plants:**
  - **Power Plant Site 1 (PPS1)** – PPS1 will be developed in two stages with the operation of five GE TM2500 ('TM units') in open cycle gas turbine (OCGT) mode (Stage 1a) and combined cycle gas turbine (CCGT) generating mode (Stage 1b). A spare TM unit gas turbine (LM2500 G4) will be stored on site to be used as replacement to the extent it may be required to installed as a replacement unit.
  - **Power Plant Site 2 (PPS2)** – PPS2 is located immediately north of PPS1, and west of the tank farm site. The design includes for 4 LM6000 PC Sprint variant units ('LM units') operating in CCGT mode. A spare unit gas turbine (LM6000 PC) will be stored on site to be used as replacement to the extent it may be required to installed as a replacement unit. It is not expected that Stage 2 would operate in open cycle mode; however, the design includes bypass stacks to allow open cycle operation if required.
- **LPG Pipeline** – A pipeline will transport LPG from the existing Tema Oil Refinery (TOR) jetty to the TOR plant site, through to the new project tank farm and then to the PPS1 and PPS2.
- **Tank Farm** – A new tank farm for storage of LPG prior to use by PPS1 and PPS2, will be constructed.
- **DFO Pipelines** – pipelines are required to transport DFO stored at the Quantum petroleum site to PPS1 and PPS2. The pipelines will follow a new Right of Way (RoW) along with the LPG routes between the tank farm and power sites.
- **Power evacuation** - Evacuation of the power for Stage 1a will be via underground connection to the existing Electricity Company of Ghana (ECG) Station H substation, adjacent to the Volta River Authority (VRA) Tema Thermal Power Complex (TTPC) at 33kV. Stage 1b evacuation will initially be via a new 161kV spur into a new double circuit 161kV overhead line to be constructed by GRIDCO by early 2018, which will run adjacent to the existing overhead lines that run east-west along the northern boundary of the Stage 2 site (PPS2). Stage 2 evacuation will be via a new substation into the new GRIDCO 161kV power lines. The Stage 1b evacuation spur will be transferred to the Stage 2 substation as that switch yard is completed.
- **Water Pipelines** – A new pipeline will run from a Ghana Water Company (GWC) municipal supply network connection, approximately 900m south of the LPG tank farm. This pipeline will connect the municipal supply network to water storage facilities to be constructed within the LPG tank farm for fire protection purposes.

Water pipeline spurs from the pipeline connecting to the municipal supply will supply water storage facilities located within the Stage 2 site to serve the water needs of both the Stage 1 and Stage 2 power facilities.

The project will be designed for an operational life of at least 25 years. At the end of its life, the project will be decommissioned and the sites reinstated as agreed with the relevant authorities. Decommissioning will consider the environmental legislation and the technology available at the time. Any necessary licences or permits will be acquired.

### 1.3 Objectives and Scope of the ESMP

The objectives of the ESMP are to:

- Describe all mitigation measures and actions identified during the ESIA process requiring implementation during the design, construction and operation (and decommissioning where appropriate) phases of the project, to enhance positive benefits and eliminate or reduce key identified biophysical, socioeconomic and health issues and impacts to acceptable levels.
- Identify key environmental and social reporting requirements, such as audits of performance which the project will need to develop and undertake throughout construction, operation and decommissioning.
- Identify and describe monitoring required as identified within the ESIA to ensure that the reporting commitments are met.
- Identify actions required to implement the above and the roles and responsibilities of parties involved (e.g. within the client organisation, designers, contractors and operators) in administering the various actions.
- The scope of the ESMP is to provide information to meet the above objectives for the construction, operation and decommissioning phases of the project, including both general environmental and social requirements that are common to most construction projects, and specific environmental and social initiatives unique to the development phases and infrastructure of this project.

The actions within this ESMP must be used as a basis by the project owners, designers, engineering procurement contractor(s) (EPC) and potential future owners to develop their own suite of Health, Safety, Security and Environmental (HSSE) Management Plans and Systems for the construction, operation and decommissioning phases of the project.

This ESMP is a live document that will last the lifetime of the project and will be updated as the project proceeds.

### 1.4 Roles and Responsibilities

Table 1-1 below outlines the roles and responsibilities of the parties involved in the implementation of the ESMP.

**Table 1-1: Roles and Responsibilities**

Party	Responsibilities
Early Power Limited	<p>This document will be used as a guide by EPL in the development of subsequent detailed management plans for all project phases.</p> <p>EPL will be responsible for ensuring compliance by the project and project contractors to EPL's HSSE plans and systems, including the requirements of this ESMP.</p> <p>EPL must ensure that national and international WBG / IFC standards met for the duration the project.</p> <p>EPL have appointed an Owner's Engineer whose responsibilities will include review and oversight of the EPC Contractors HSSE plans and systems and conformance with the requirements of this ESMP.</p> <p>EPL will undertake regular audits of their onsite contractors to verify compliance with EPL's and contractors own HSSE management plans and systems.</p>
EPC contractor(s)	<p>The contractor will appoint an HSSE team to develop and implement HSSE Management Plans and Systems for the construction phase. These will be approved by EPL.</p>
HSSE team for the construction phase	<p>Drafting of appropriate HSSEs management plans and systems for the construction phase (and Decommissioning Management Plans in the future), which will include all of the aspects covered in this ESMP.</p> <p>The implementation and enforcement of actions required by the HSSE plans and systems , including any monitoring requirements and reporting.</p> <p>The training of workers in how to perform tasks required by the detailed management plans.</p> <p>The provision of all required items including safety equipment and emergency response equipment required by the management plans.</p> <p>Management of waste contractors and other external contractors and consultants used in the construction / decommissioning phases of the project.</p> <p>Updating the management / systems plans with any required changes as the project progresses.</p>
Waste Contractors	<p>Responsible to the collection and disposal of wastes to appropriate disposal facilities. The contractors must abide by the standards specified within this ESMP and within EPL's / Contractors management plans.</p>

Party	Responsibilities
Plant Owner / Operator	The owner will need to appoint an HSSE team to develop and implement HSSE Management Plans and Systems for the operational phase.
HSSE team for the operational phase.	<p>Drafting of the detailed HSSE or equivalent documents, which will include all of the operational aspects covered in this ESMP.</p> <p>The implementation and enforcement of actions required by the detailed management plans, including any monitoring requirements and reporting.</p> <p>The training of workers in how to perform tasks required by the detailed management plans.</p> <p>The provision of all required items including safety equipment and emergency response equipment required by the management plans.</p> <p>Management of waste contractors and other external contractors and consultants used in the operational phase of the project.</p> <p>Updating the management plans with any required changes as the project progresses.</p>
External Consultants	May be used to undertake monitoring works and reporting in both the construction and operational phase. The consultants must abide by the standards specified within this ESMP and within the detailed management plans drafted by the relevant HSSE teams.
EPA / Regulating Bodies	<p>Ensure that monitoring and reporting requirements (as required by the ESMP and detailed management plans in accordance with EPA standards and guidelines).</p> <p>Enforce any actions that may be needed to ensure environmental quality standards are not breached and permit requirements are maintained.</p>
International Financing Institution	The International Finance Institutions will develop its own Environmental and Social Action Plan (ESAP) that will include conditions to be met. The ESAP will include the requirement to comply with, among other plans, the ESMP.

## 1.5 Implementation of the ESMP

### 1.5.1 Overview

This ESMP provides a framework document to be used throughout the lifetime of the project. It forms the basis on which more detailed plans will be developed. The action and standards specified within this ESMP must be adopted in the development and implementation of detailed management plans. The parties involved in the implementation of the ESMP and their roles and responsibilities are outlined in Table 1-1. HSSE teams will be appointed for each project phase and they will be responsible for ensuring implementation of the ESMP.

### 1.5.2 Training

Training of construction and operational workforce is required to ensure they can safely and effectively carry out the actions required by the ESMP. Procedures for training must be developed and implemented for each project phase. Training procedures will be periodically reviewed and updated. Training records must be kept and maintained.

### 1.5.3 Monitoring

Monitoring is required to ensure the actions specified in the ESMP to mitigate environmental and social impacts are effective. Monitoring and reporting must be undertaken for each project phase, on a daily, weekly, monthly, quarterly or annual basis, depending on the action. The monitoring period for each action will be specified.

### 1.5.4 Audit and Inspections

Internal audits and inspections are required throughout each project phase, on a regular basis, to ensure that the requirements of the ESMP are being undertaken. The audits and inspections should be undertaken to the standards specified within the detailed project HSSE Management Plans / Systems. The frequency of inspections will vary depending on the nature of activities. Inspection records should be maintained and kept up to date.

External audits and inspections by regulating authorities (e.g. the EPA) will also be undertaken throughout the lifetime of the project.

### 1.5.5 Reporting

Reporting of monitoring undertaken must be supplied to the relevant person/organisation(s) as specified within management plans developed by the relevant HSSE teams.

During the operational phase annual reporting of project emissions to the EPA is mandatory to fulfil the requirements of the Environmental Permit for the project. Other monitoring works required by this ESMP for all project phases must be reported to the EPA and to the IFI where specified. Detailed reporting requirements and procedures are to be developed by the HSSE teams for each project phase.

### 1.5.6 Change Management

The ESMP is a working document and will be updated in line with any changes to project requirements or as a result of annual HSSE reviews. The relevant HSSE teams will be responsible for ensuring that changes are incorporated into the relevant management procedures and implemented.

## 1.6 Legal Requirements

### 1.6.1 Overview

The project is required to comply with the relevant Ghanaian law and regulations implementing and other national legislation and policy relevant to project activities. The project must also comply with international conventions to which Ghana is a signatory and with the relevant international standards, as described below in Section 1.6.3.

### 1.6.2 National and Local Regulation

The Constitution of Ghana (1992) states that *'the State shall take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek cooperation with other states and bodies for purposes of protecting the wider international environment for mankind'* (Section 6 (41) (9)).

National Environmental regulation within Ghana falls under the requirements of the Environmental Protection Agency Act 1994 (Act 490) and the Environmental Assessment Regulations 1999 (LI 652).

At local level, the project will be governed and follow the requirements of the Tema Metropolitan Assembly. The assembly exercises Deliberative, Legislative and Executive functions, including approval of development plans and enforcement of by-laws.

### 1.6.3 International Regulation

The project will meet the requirements of the IFC Performance Standards and associated WBG EHS guidelines.

The IFC has issued eight Standards for Social and Environmental Sustainability (2013) ("IFC Performance Standards") which will be applied throughout the lifetime of the project:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts (PS1);
- Performance Standard 2: Labour and Working Conditions (PS2);
- Performance Standard 3: Resource Efficiency and Pollution Prevention (PS3);
- Performance Standard 4: Community Health, Safety, and Security (PS4);
- Performance Standard 5: Land Acquisition and Involuntary Resettlement (PS5);
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (PS6);
- Performance Standard 7: Indigenous Peoples (PS7); and,
- Performance Standard 8: Cultural Heritage.

Other relevant IFC/WBG standards for the project include: General EHS Guidelines (2007), EHS Guidelines for LNG facilities (2007), EHS Guideline for Electric Power Transmission & distribution (2007) and EHS Guidelines for Thermal Power (2008). Together, these established international standards shall be met throughout the life of the project.

In addition, Ghana is signatory to a number of international conventions. These are listed in Table 1-2.

**Table 1-2: Treaties and Conventions Applicable to all Aspects of the Project**

<b>Treaties and Conventions</b>	<b>Year Ratified</b>
<b>Conventions regarding Ecology and Biodiversity</b>	
International Convention for the Conservation of Atlantic Tunas	1966
African Convention on the Conservation of Nature and Natural Resources	1968
The Convention on Wetlands of International Importance Especially Waterfowl Habitat (RAMSAR Convention)	1971
The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington	1973
Convention on the Conservation of Migratory Species of Wild Animals	1979
International Convention for the Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region- the Abidjan Convention	1981
Convention on Biological Diversity	1992
Agenda 21 of the United Nations Conference on Environment and Development (the Rio Declaration)	1992
United Nations Convention on Biological Diversity	1996
United Nations Convention to Combat Desertification	1997
CMS Memorandum of Understanding Concerning Conservation Measures for Marine Turtles off the Atlantic Coast of Africa	1999
<b>Conventions regarding Climate Change</b>	
The Vienna Convention on the Protection of Ozone Layer	1993
Montreal Protocol on Substances that Deplete the Ozone Layer	1993
United Nations Framework Convention on Climate Change	1996
Kyoto Protocol to the FCCC	1997
<b>Conventions regarding Pollution</b>	
International Convention on Civil Liability for Oil Pollution Damage	1969
International Convention on the Establishment of an International Fund for Compensation of Oil Pollution Damage	1971
International Convention of Oil Preparedness, Response and Co-operation (ORPC)	1990
Stockholm Convention	2001
<b>Conventions regarding Social and Cultural Aspects</b>	
Convention 29 on Forced Labour Convention	1930
ILO Convention 87 on Freedom of Association and Protection of the Right to Organize Convention	1948
ILO Convention 98 on the Right to Organize Collective Bargaining	1949
Convention 100 on Equal Remuneration	1951
Supplementary Convention on the Abolition of Slavery, the Slave Trade, and Institutions and Practices similar to Slavery	1956
Convention 105 Concerning the Abolition of Forced Labour	1957
Convention 111 on Discrimination	1958

Treaties and Conventions	Year Ratified
International Convention on the Elimination of All Forms of Racial Discrimination	1969
The Convention Concerning the Protection of World Cultural and Natural Heritage	1972
International Covenant on Civil and Political Rights	1976
African Charter on Human and Peoples' Rights	1989
International Covenant on Economic, Social and Cultural Rights	2000
<b>Conventions regarding Pollution, Chemicals and Wastes</b>	
Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movements of Hazardous Wastes within Africa	1990
Rotterdam Convention of Prior Informed Consent Chemicals	1998
The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	2003

## ISO 14001

For the operational phase of the project, the EMSP should be developed in line with the requirements of ISO 14001. This is an internationally accepted standard that outlines how to put an effective EMS in place. It is designed to allow organisations to implement and maintain a preventative approach to environmental and social management, and to report on performance.

### 1.7 Updates to the ESMP

As the project progresses and detailed design is concluded, a greater level of certainty will be available regarding the project's impacts and the environmental and social aspects that will be required for management during construction, operation and decommissioning. The EPC contractors will develop and implement more detailed environmental management plans to cover all aspects of the project.

### 1.8 Information Disclosure and Stakeholder Engagement

As part of its project team vision and delivering on its core values, EPL will continue to engage with stakeholders throughout construction, operation and decommissioning of the project, in line with the requirements of the Stakeholder Engagement Plan (SEP).

Communication with local communities and other local stakeholders will be a key part of this engagement process and is one where EPL and the contractor will need to work closely together during the construction period.

The objectives of communication and liaison with local communities are the following:

- To provide stakeholders in the vicinity of the project and along the pipeline route and access roads, and other interested stakeholders, with regular information on the progress of work and its implications.

- To monitor implementation of mitigation measures and the impact of construction on communities via direct monitoring and feedback from those affected in order to ensure that mitigation measures are implemented and the mitigation objectives achieved.
- To manage any disputes raised by the EPC contractor(s) and the local community.

As part of the disclosure activities, prior to the commencement of construction, relevant impact management plans (e.g. Traffic Management Plan and emergency preparedness and response plan) and other key documentation (including this ESIA, the SEP and the project grievance mechanism) will be disclosed on the EPL project website. These aspects were also disclosed during the June 2017 community focus group meeting.

### 1.9 Summary of Management Plan requirements

The following are recommended plans that will need to be developed and implemented as part of the Project’s ESMS, including health, safety, security and environmental (HSSE) requirements. Each plan should be developed by the indicated responsible party for the relevant project phase. It is noted that the selected EPC contractor for Stage 1 has already prepared relevant plans for construction, as confirmed in the ‘status’ column below.

If Stage 2 is to be awarded to a separate EPC Contractor, it will be necessary for the new Stage 2 EPC Contractor to develop and implement an additional set of the relevant HSSE management system documents for Stage 2.

**Key: W = write R = review C = consult I = inform**

Responsibility for Delivery	Responsibility for Delivery			Status <sup>1</sup>
	EPL	Jacobs	EPC Contractor	
<b>Basis of ESM System for project company EPL - for construction and operation</b>				
1. Environmental and Social Policy	C/I	W	I	Complete for construction
2. ESMS Manual	C/I	W	I	
3. Aspects Register	C/I	W	I	
4. Legislative Register	C/I	W	I	
<b>Detailed Plans or Procedures<sup>2</sup></b>				
<b>Pre-construction and Construction Phases - EPC</b>				
Overarching health, safety, security and environmental management system – including the following specific environmental and social plans or equivalent documentation:				Complete for Stage 1 EPC
• Construction Environmental Management Plan	C	R	W	
• Traffic management and road safety incl management of community traffic risks	C	R	W	
• Water Supply and Quality Management Procedure	C	R	W	
• Storm water and Wastewater Management Procedure	C	R	W	
• Waste Management	C	R	W	

• Hazardous Materials Storage and Handling Procedure	C	R	W	
• Emergency Preparedness and Response, including community emergency preparedness and response plans.	C	R	W	
• Ecological Monitoring and Management Procedure	C	R	W	
• HIV/AIDS Awareness and Prevention	C	R	W	
• Worker Policy: Code of Behaviour	C	R	W	
• Training procedures	C	R	W	
• Pipeline safety management plan including management of pipeline construction community safety risks	C	R	W	TBC
<b>Pre-construction and Construction Phases – EPL</b>				
• Abbreviated Resettlement Action Plan (Stage 1)	C	W	I	Stage 1 complete
• Abbreviated Resettlement Action Plan (Stage 2)				In progress
• Stakeholder Engagement Plan (inc Grievance Mechanism)	C	W	I	Complete
• Social Investment Strategy	W	R		Draft
<b>Plant Operating Phase - to be completed prior to commercial operational date (COD)</b>				
Overarching health, safety, security and environmental management system – including the following specific environmental and social plans:				To be developed prior to COD
• Pre-construction updates to ESMS documents and SEP.	W	R	I	
• Air Emissions Management and Monitoring Plan	W	R	I	
• Ambient Noise Management and Monitoring Procedure	W	R	I	
• Water Supply and Quality Management Procedure	W	R	I	
• Storm water and Wastewater Management Procedure	W	R	I	
• Waste Management	W	R		
• Hazardous Materials Storage and Handling Procedure	W	R		
• Emergency Preparedness and Response Plan, including community emergency preparedness and response.	W	R		
•	W	R	W	
• HIV/AIDS Awareness and Prevention	W	R		
• Worker Policy: Code of Behaviour	W	R		
• Training procedures	W	R		
• Decommissioning strategy	W			

Notes:

1) The status column confirms where relevant plans have been developed. The plans are all considered live documents and should be reviewed and updated throughout the relevant project phase. Implementation of the plans is the responsibility of the relevant owner.

2) The list of required documents may be added to or reduced, depending on what the approach the EPC Contractor / site operator takes to developing their HSSE management system.

## 2 Environmental and Social Management Plan Actions

The following section of the ESMP contains two tables. Table 2-1 summarises the key environmental and social actions that are required to be initiated prior to construction. Table 2-1 of the ESMP can be used to form the basis of an environmental and social action plan for the international financial institutions financing the project to ensure the ongoing project commitment to addressing, managing and mitigating all identified environmental and social impacts.

Table 2-2 contains environmental and social actions identified to be implemented during construction, operation and decommissioning of the project. This Table includes specific actions identified through assessment and references modelling undertaken for the ESIA.

Where mitigation measures or actions are the responsibility of the EPC Contractor, these apply to both the Stage 1 and Stage 2 Contractor. In the event that the two Stages are completed by different EPC Contractors, this may mean that additional construction phase management plan documents will be required for Stage 2.

**Table 2-1: ESMP for the Ghana Bridge Project – Actions Requiring Implementation Prior to Construction**

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment / KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
<b>Socio-Economics</b>						
Prior to construction of Stage 1	Economic and / or physical displacement of farmers and kiosk owners/inhabitants associated with Stage 1 site and original pipeline route.	<p>Prepare and implement an Abbreviated Resettlement Action Plan (ARAP) including livelihood restoration measures for the kiosk vendors, resident along the pipeline route and farmers on PPS1.</p> <ol style="list-style-type: none"> <li>1. Collect census level data on income and consider vulnerability of kiosk businesses.</li> <li>2. Develop a system for compensation for crop loss on PPS1;</li> <li>3. Develop appropriate measures, including compensation for resettlement of the inhabitants of the kiosks;</li> <li>4. Continue consultation with the affected persons according to the requirements of IFC PS1 including the establishment of a grievance mechanism for the project that would be available to the local community; and,</li> <li>5. Where determined as required by the outcomes of the above activities, provide training and livelihood assistance programs to the community including, for example, the potential to diversify, savings and credit opportunities, and business and enterprise training.</li> </ol>	EPL	IFC PS 5	EPL to implement ARAP, independent third party to monitor implementation of LRP.	Stage 1 ARAP completed and partially implemented in March 2017. Remaining implementation steps (relocation of remaining kiosks) to take place prior to Stage 1 EPC Contractor notice to proceed
Prior to construction of Stage 2 and prior to operation of Stage 1	Economic and / or physical displacement of farmers, inhabitants and kiosk owners/inhabitants associated with Stage 2 site and revised pipeline route.	<p>Prepare and implement an ARAP including livelihood restoration measures for Stage 2 project affected persons (PAPs).</p> <ol style="list-style-type: none"> <li>1. Develop Stage 2 ARAP in line with the above approach.</li> <li>2. In the event of further changes to the pipeline alignment which could result in additional displacement impacts. These to be addressed through the Stage 2 ARAP as appropriate.</li> </ol>	EPL	IFC PS 5	EPL to implement ARAP, independent third party and / or lenders to monitor implementation of LRP.	Stage 2 ARAP to be completed prior to notice to proceed for Stage 2 or Stage 1a COD, whichever is earlier.
Prior to construction of Stage 2 and prior to operation of Stage 1	Economic and / or physical displacement of inhabitants and commercial users of the Stage 2 site. Resettlement activities to be undertaken by the land owner.	<ol style="list-style-type: none"> <li>1. A plan and timeline for resettlement of the PPS2 site occupants by the land owners will be agreed with and monitored by EPL.</li> <li>2. Any additional actions required to meet the requirements of IFC PS5 will be addressed via a Supplemental Action Plan if required.</li> </ol>	EPL	IFC PS 5	EPL to monitor implementation of landowner resettlement	Prior to notice to proceed for Stage 2 or Stage 1a COD, whichever is earlier.
<b>Traffic and Transport</b>						
Prior to construction	Construction traffic management		EPC Contractor (s)	Ghana EPA and IFC PS 4 requirements.	EPA / EPL	Following detailed design.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment / KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		<ol style="list-style-type: none"> <li>Develop a traffic management plan for the sites ensuring that HGV traffic movements will be managed and spread evenly over the working day to minimise on-site and off-site congestion and including coordination to ensure timely supply of materials at construction, planning and scheduling of ship arrivals will take place in partnership with operators of Tema Port.</li> <li>EPC Contractor to liaise with the Ghana Highway Authority, the DFR and the DUR prior to start of construction (and during construction).</li> </ol>				
Prior to construction	Potential Cumulative traffic impacts during construction	<ol style="list-style-type: none"> <li>Consultations with other developers and operators to be undertaken prior to commencement of project and throughout the project lifetime to identify any potential cumulative traffic impacts.</li> <li>Following the confirmation of construction timescales for this project and other proposed projects in the area, develop a combined traffic management plan if required, including scheduling of deliveries to site / exports from site to avoid busy periods.</li> <li>Confirm outcome of consultations and decision process with EPL prior to commencement of significant construction activities.</li> </ol>	EPC Contractor(s).	Ghana EPA and IFC requirements	EPL to review outcome of consultations to confirm if cumulative impacts are an issue and sign off EPC Contractor's proposed approach to managing potential cumulative transport impacts, if required.	Within four weeks of notice to proceed and prior to start of significant construction vehicle traffic
<b>Water Resources and Flood Risk</b>						
Prior to construction	Minor flood risk potential from fluvial flooding	<ol style="list-style-type: none"> <li>In order to consider the implications of a 0.1% AEP flood event, with an additional allowance for potential climate change and urbanisation-related increases in flows, sensitive infrastructure should be raised to 600mm above the predicted peak water levels for 'sensitivity' scenario flood event. As such, unless further work is done to refine the results of the FRA, the sites and/or sensitive infrastructure should be raised to a minimum of: <ul style="list-style-type: none"> <li>PPS1 - 31.72m AD (WSG84) (16.34m AMSL); and,</li> <li>PPS2 - 33.61m AD (WSG84) (18.23m AMSL).</li> </ul> </li> <li>Consider fluvial flood risk when designing site perimeter and internal storm drainage.</li> <li>Once finalised, the EPC Contractor should ensure its design is reviewed by a competent hydrologist or flood risk engineer to confirm that the issues/ requirements highlighted have been adequately addressed.</li> </ol>	EPC contractor(s).	Ghana EPA and IFC requirements.	EPL to review EPC Contractor's proposed flood and drainage design to ensure finished levels are equal to or above 31.52mAD (WSG84 datum).	Pre- construction.
Prior to construction	Potential for fluvial flooding of main access road (Valco Road)	<ol style="list-style-type: none"> <li>Planning for site access and egress, including emergency response, should therefore consider the potential for flood related closure of the Valco Road access and confirm the alternative route from the high ground to the north;</li> <li>EPC Contractor to consider in construction risks; EPL to consider for operational risks.</li> </ol>	EPC Contractor(s) EPL / Operator	Ghana EPA and IFC requirements	N/A	Pre-construction
Prior to construction	Potential future increases in flood risk associated with poor drainage planning	<p>EPL to engage with Kpone District Authority (KKDA), Tema Development Corporation (TDC) and other stakeholders as required with regard to the long term planning of storm drainage within the catchment. This discussion should include:</p> <ol style="list-style-type: none"> <li>Confirmation of the drainage maintenance regime and responsibilities, and that the drainage maintenance programme will continue indefinitely.</li> </ol>	EPL	N/A	EPA	Within detailed design

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment / KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		<p>2. Consultation should also discuss the long term management of drainage and potential flood risk with respect to increasing development within the catchment and the potential flood-related issues associated with the capacity of the culvert to the south of Valco Road, and climate change-related incremental increases in rainfall.</p> <p>In the event that appropriate flood risk and drainage planning is not in place, EPL to advocate for this.</p>				
Prior to construction	Pluvial flood risk and site drainage	<ol style="list-style-type: none"> <li>1. Installation of perimeter and on-site storm drainage infrastructure of sufficient capacity to accommodate predicted wet season overland flows and any potential increase in flows due to future development in the catchment and potential climate-change related increases in rainfall.</li> <li>2. The project may wish to consider installation of formal roadside drainage for areas immediately adjacent to the site, which should be connected to the main storm drain unless another feasible design solution can be confirmed. The project may wish to assume from an operational stand point that the local authority has insufficient budget to maintain the drains in the vicinity of the site and include periodic maintenance within the project cost plan.</li> <li>3. The drainage design should avoid increasing site runoff or displacing storm flows onto other adjacent developed sites unless the receiving systems have been specifically designed to accommodate these flows. This may require design of storage and attenuation capacity within the site drainage system to prevent an increase in peak runoff.</li> </ol>	EPC Contractor	Ghana EPA and IFC requirements.	N/A	Pre- construction.
Prior to construction	Flood risk to the LPG pipeline at water crossings	<ol style="list-style-type: none"> <li>1. Consideration should be given to routing the LPG pipelines underground in the vicinity of watercourses to avoid any constriction of flows and risks to the supporting structures. Alternatively, crossings should provide at least 0.6m freeboard between the top of the watercourse bank and the soffit level of the crossing and be designed to be resilient to impact from debris.</li> <li>2. The pipeline crossing for storm drain (Watercourse 2) has already been completed in the form of an underground crossing which mitigates risk at this location.</li> </ol>	Early Power	Ghana EPA and IFC requirements.	N/A	Pre- construction.
Prior to construction	Pluvial flood risk to the LPG pipeline within the TOR pipeline Right of Way (ROW)	<ol style="list-style-type: none"> <li>1. EPL to engage with TOR to identify the flood-prone rail culverts along the ROW which may have contributed to previous safety issues.</li> <li>2. EPL should investigate the conditions at these locations and consider if it can contribute to improving the drainage at these locations in partnership with TOR or find an appropriate alternative design solution to reduce the risk to the project LPG pipeline.</li> </ol>	EPL	IFC PS 4	N/A	Prior to finalisation of the project LPG pipeline detailed design
Prior to construction	Groundwater - tank excavations	<ol style="list-style-type: none"> <li>1. The hydraulic properties of the soils and shallow geology should be investigated as part of the design process. Once this is understood, appropriate precautions in terms of tanking and pumping may be required to control groundwater levels and ingress rates.</li> </ol>	EPC contractor(s)	N/A	EPL to ensure relevant assessment completed	Within detailed design

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment / KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
<b>Climate Change/Greenhouse Gas Emissions</b>						
Prior to construction	Potential climate change related-increases in fluvial or pluvial flood risk	1. Implementation of design mitigation included for flood risk above.	EPC Contractor(s).	Ghana EPA and IFC PS 3 requirements.	N/A	Pre- construction.
Prior to construction	Risk of temperature increase due to climate change could decrease the efficiency of the plant.	1. The sensitivity of the project to temperature change could be modelled against predicted changes in temperature to determine the impact on the CCGT's output over the project lifetime. 2. If impacts are noted, consideration could be given to the development of appropriate mitigation measures based on the modelling outcomes. These could include coinciding maintenance shutdowns with periods of high temperatures that are likely to have the most significant impact on the plant's efficiency should this be appropriate.	EPL	Ghana EPA and IFC PS 3 requirements.	N/A	Pre- construction.
Prior to construction	Greenhouse Gas (GHG) emissions	It is recommended that, where practicable, EPL evaluate technically and financially feasible and cost-effective options to reduce or offset project-related GHG emissions during the design and operation of the project.	Early Power	Ghana EPA and IFC PS 3 requirements. and IFC/WBG Guidelines	N/A	Pre-construction.
<b>Noise</b>						
Design	Generation of noise from operational activities.	The sound power levels quoted by the suppliers and used in the noise assessment should be considered maximum permissible values for equipment as the design progresses to ensure that the environmental effects are no worse than stated in the assessment.  The following general mitigation measures should be employed in plant design: 1. Silencers (attenuators) on all gas turbine air intakes. 2. Silencers (attenuators) on the bypass / HRSG system. 3. Steel turbine enclosures.	EPL EPC Contractor(s)	Ghana EPA and IFC requirements.	N/A	Detailed design and review throughout operational lifetime of the project.
Design	Stage 1a noise impacts on adjacent worker accommodation with business owners	1. Stage 1a mitigation measures to protect adjacent worker accommodation should be agreed with Stage 1a business owners prior to construction. 2. EPL to undertake additional consultation as required and have documented agreement in place (e.g. in the form of a Memorandum of Understanding and/or a letter of no objection).	EPL	Ghana EPA and IFC requirements.	EPL to obtain written agreement (e.g. Memorandum of Understanding)	
<b>Waste and Materials</b>						
Prior to construction	Potential adverse effects on the environment through utilisation of unsustainable construction material sources	1. Audit of sustainable sourcing of construction materials 2. If new or unlicensed quarries are to be used for materials, an ESIA of the quarry site is to be undertaken. 3. Prior to acceptance of construction materials, auditing of source facilities (e.g. quarries) is to be undertaken to ensure they have appropriate licences and ESMPs etc. in place.	EPC contractor(s)	Ghana EPA and IFC PS 3 requirements.	EPC Contractor's internal audit EPL's independent audit EPA audit,	Upon commissioning of the EPC Contractor.
Prior to construction	Pollution of the surrounding environment through improper management and disposal of wastes.	An appropriate waste management plan covering the entire Project life cycle will be developed as part of the ESMP and will include the following principles:  1. Application of the waste management hierarchy (reduce, reuse, recycle and dispose);	EPC contractor(s)	Ghana EPA and IFC PS3 requirements.	Visual inspection.	Prior to construction activities commencing.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment / KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		<ol style="list-style-type: none"> <li>2. Handling and storage of wastes in a manner that prevents uncontrolled release to the environment;</li> <li>3. Segregation of non-hazardous and hazardous wastes; and</li> <li>4. Transfer and disposal of arisings and wastes in accordance with legal requirements.</li> </ol> <p>Waste disposal contractors, treatment facilities and waste disposal sites will be audited prior to use to ensure they meet the required national regulatory, EPA and good international industry standards.</p>				
<b>Land Quality</b>						
Prior to Stage 2 construction	Identified localised contamination on Stage 2 site	<ol style="list-style-type: none"> <li>1. Prior to construction, the EPC Contractor's proposed solution to management and disposal solution, including the registered receiver of any waste, for the identified DFO contamination on Stage 2 site should be agreed with EPL.</li> <li>2. An audit of the receiving facilities should be undertaken and associated documentation provided for review by EPL.</li> </ol>	EPC Contractor(s)	Ghana EPA and IFC PS3 requirements.	EPL to review Contractor design and documentation.	Prior to Stage 2 construction activities commencing.

**Table 2-2: Ghana Bridge Power– Construction, Operational and Decommissioning Actions**

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
<b>Land Quality (for issues specific to waters see also water and wastewater)</b>						
Construction and Operations	Potential existing contamination – Main Sites and Pipeline	<p>The following actions should be adopted to manage general risks associated with existing and potential contamination:</p> <ol style="list-style-type: none"> <li>1. Available investigation information should be submitted to the appointed Contractor (or to Contractors during tendering), to develop safe systems of work;</li> <li>2. Workers should be briefed on visual indicators of contamination (e.g. signs of oil, chunks of fibrous material) and procedures established for reporting and management to maintain safe working conditions;</li> <li>3. On a precautionary basis, good practices should be implemented to minimise exposure to vapours, soil and liquid arisings during construction work, including minimisation of fugitive dust emissions and appropriate hygiene measures; and</li> <li>4. The presence of unknown areas of contamination or below ground obstructions should be anticipated and appropriate contingency allowed for assessment and remediation should any such areas of contamination be identified during construction.</li> </ol>	EPC contractor(s) / Decommissioning contractor(s).	Ghana EPA and IFC PS 3 and 4 requirements. Site inspection records.	Regular site inspections to monitor conditions.	Throughout construction and decommissioning phases.
Construction	Spills, leaks, failure of tanks or pipelines or deliberate discharges of hazardous materials could occur during construction. Substances may include raw materials, fluids, intermediate products, wastes and effluents.	<ol style="list-style-type: none"> <li>1. Training of workers in the handling, storing and disposal of hazardous materials.</li> <li>2. In the event of an accidental release of hazardous materials, emergency procedures and management plans will be in place so that any spills or leaks can be contained immediately;</li> <li>3. Storage of potentially hazardous construction materials will take place on hard surfacing and within appropriate containers. Where necessary, these would be covered and incorporate spill or leak containment measures;</li> <li>4. Chemicals that would react together if brought into contact will be located in segregated storage areas;</li> <li>5. Emergency spill containment material and clean up equipment will be readily available; and</li> <li>6. Drainage design and management will ensure that potentially contaminated surface run-off does not flow directly into watercourses without treatment. This should include any areas where cement or wet concrete is processed or stored.</li> </ol>	EPC contractor(s).	Ghana EPA and IFC PS 3 and 4 requirements.	Periodic sampling of soil/fill materials brought for use in construction.	Throughout the construction period.
Construction and Operations	Contamination of ground, groundwater and surface water bodies following spills, leaks, failure of tanks or pipelines or deliberate discharges. Substances may include raw materials, fluids, intermediate produces, wastes and effluents.	<ol style="list-style-type: none"> <li>1. Workers will be trained in the handling, storing, and disposal of hazardous materials. In the event of an accidental release, emergency procedures and management plans will be in place so that the spill can be contained immediately, cleaned and disposed appropriately;</li> <li>2. Chemicals will be stored in designated bunded areas with bunds having the capacity to contain at least 110% of the volume of chemicals stored;</li> <li>3. Wherever possible, there will be no bund wall penetration and all pipework will be routed over the bund wall;</li> <li>4. Operational storage tanks will be designed and constructed in accordance with internationally recognised standards (such as BS EN 14015 or API 650) ensuring they are robust and fit for purpose;</li> </ol>	EPC Contractor (s) Plant owner / operator(s).	Ghana EPA and IFC PS 3 and 4 requirements.  Maintenance and inspection records to verify integrity of containment / ground surfacing. IFC EHS and EPA discharge limits and soil and water quality standards.	Visual inspection of containment systems. Visual inspections of drainage channels to ensure no presence of contaminants.	Throughout the operational lifetime of the project.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		<ol style="list-style-type: none"> <li>5. Chemicals that will react together if brought into contact will be located in segregated storage and banded areas;</li> <li>6. Operational areas and roads where spills or leaks of hazardous materials could occur will be constructed in low permeability hardstanding to minimise potential for infiltration of contaminants to ground;</li> <li>7. Emergency spill containment response procedures will be in place, and materials and clean up equipment will be readily available;</li> <li>8. Drainage design and management will ensure that potentially contaminated surface run-off does not flow directly into watercourses. Stormwater / surface water run-off will be channelled to oil separators / interceptors and silt traps prior to disposal to outfalls; and</li> <li>9. The pipeline design in the buried sections should consider the potential use of the overlying ground following completion of construction, particularly in those areas currently used as temporary parking for tankers and other vehicles.</li> <li>10. Preparation of appropriate environmental management plans for construction and operations phases.</li> </ol>				
<b>Air Quality</b>						
Construction and Decommissioning	Fugitive dust generation during construction and decommissioning phase	<ol style="list-style-type: none"> <li>1. Plant and equipment will be designed and used in a manner which minimises dust generation;</li> <li>2. Dampening (using water or some other environmentally benign dust-suppressant material) of un-surfaced areas, soils and spoil may be undertaken to prevent dust re-suspension during hot, dry weather conditions with relatively high wind speeds;</li> <li>3. Careful location, grading and management of stockpiles of soil and similar materials will be undertaken to prevent wind-blow or taken off-site;</li> <li>4. Sealing and / or re-vegetation of completed earthworks will be undertaken as soon as reasonably practicable;</li> <li>5. Where possible, site roads will be surfaced early in the construction programme – with vehicle speeds limited to an appropriately low speed to minimise re-suspension of dust from surfaced and un-surfaced roads;</li> <li>6. Regular cleaning of surfaced roads and maintenance of un-surfaced roads will be undertaken to reduce off-site transport of soils and to avoid dust generation;</li> <li>7. Lorries will be sheeted during transportation of friable construction materials and spoil and wheel wash facilities made available during adverse conditions;</li> <li>8. Drop heights will be minimised during material transfer activities, such as unloading of friable materials; and,</li> <li>9. Positioning and movement of construction equipment will be undertaken in a manner which minimises dust generation.</li> </ol>	EPC contractor(s).	Complaints from workers / neighbouring communities'	Obtain verbal and documented feedback from construction workers and neighbouring communities.	Throughout construction phase. Roads to be surfaced early in construction phase. All measures applicable throughout construction/ decommissioning phases.
Construction and decommissioning	Combustion and decommissioning emissions	<ol style="list-style-type: none"> <li>1. Diesel powered construction equipment and vehicles will be well maintained to minimise exhaust emissions; and,</li> </ol>	EPC contractor(s).	Complaints from workers / neighbouring communities'	Obtain verbal and documented feedback from construction workers and neighbouring communities.	Throughout construction and decommissioning phases.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		2. Idling reduction awareness activities for onsite diesel powered equipment and mobile vehicles.				
Operations	Plant Operational Emissions	<p>Mitigation measures already included within the design will be integral to the operation of the proposed plant:</p> <ol style="list-style-type: none"> <li>The use of modern combustion technology and effective combustion to minimise the generation of NOx and CO emissions;</li> <li>The use of water abatement as an integral part of the plant design will reduce NOx emissions from the turbines operating in open cycle mode;</li> <li>The use of a low-sulphur fuel, (i.e. LPG and NG);</li> <li>Appropriately designed stacks and stack height to ensure adequate dispersion of emissions to air; and</li> <li>Continuous Emissions Monitoring Systems (CEMS) will be installed on the exhaust stacks to monitor the emissions of the relevant pollutants and associated emissions parameters in accordance with the appropriate monitoring and reporting requirements of the EPA. Provision shall be made for manual sampling of pollutants where required. Sampling points and safe access to the monitoring points shall be designed into the plant.</li> </ol> <p>Because of the dynamic emissions context and rapid development within the airshed, it is recommended to undertake an extended monitoring programme in the locality. Monthly diffusion tubes should be deployed on a continuous basis, with analysis for NOX and SO2. Timings should be according to the confirmed commissioning and operation of these external plant, especially the commissioning of the larger Karpower power ship generating capacity (although a continuous programme should pick up the step changes in levels anyway). Particulate monitoring is a complicated process, and in light of the current knowledge of a very high background, and considering that EPL will only be running on DFO for emergency temporary use, there may not be significant value in implementing a programme to look for variations due to emissions from other plants.</p> <p>The ambient air monitoring should ideally be commenced during the construction phase to collect an ongoing record of baseline conditions prior to operation and allow comparison with the operational periods of other emitters prior to EPL operation.</p>	EPC contractor(s) for installation of technology. Plant operator for implementation of abatement measures.	Negative complaints from workers / neighbouring communities'	<p>Minimum 6 monthly review of Ambient air monitoring results.</p> <p>Environmental operational monitoring reports, demonstrating compliance with EPA and IFC air emission limits.</p>	
Operation	VOC emissions from storage.	<p>Use of vapour recovery systems for vehicle fuel storage, loading / offloading, and fuelling activities.</p> <p>Loading / unloading of volatile materials will be limited during poor air quality episodes.</p> <p>Implementation of tank and piping leak detection and repair programs.</p>	Plant operator(s).	EPA ambient air quality values, EPA air quality guidelines for the energy sector, EPA limits for emissions from sources, WBG / IFC EHS Guideline LNG storage facilities.	Regular inspection and maintenance of systems described. Review of the leak detection and repair programmes.	Throughout operational lifetime of the project.
<b>Carbon / Greenhouse Gas (GHG) Emissions</b>						
Operation	Calculation of annual GHG emissions.	During operation the project calculates and discloses annual GHG emissions.	Plant operator(s).	IFC Performance Standard 3.	Use monitoring and emissions data (see Air Quality) to calculate and disclose annual GHG emissions from the facility.	Throughout operational lifetime of the project.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
Construction, operation and decommissioning	Generation of GHG emissions associated with transport movements.	Development of management plans and procedures to ensure traffic flow is minimised as far as possible and that all transportation vehicles used throughout the project are fit for purpose and adequately maintained High-efficiency low-emission vehicles to be preferentially used where possible.	EPC contractor(s). Plant Operator(s). Decommissioning contractor(s).	Ghana EPA and IFC PS 3 requirements.	N/A	Throughout the lifetime of the project.
<b>Noise</b>						
Construction and decommissioning	Generation of noise through construction activities, particularly during piling and excavation works.	Construction and decommissioning contractor to use good international industry practice (GIIP) in terms of working practices and working hours to minimise impacts to workers.	EPC contractor(s).	Ghana EPA and IFC PS 2 and 4 requirements.	Verbal and documented feedback from construction workers and neighbouring communities. Noise related complaints.	Throughout construction and decommissioning phase.
Construction and decommissioning	Generation of noise by construction vehicle movements.	Scheduling of road traffic movements to avoid noise sensitive periods (e.g. night-time). Route traffic away from noise sensitive receptors.	EPC contractor(s).	Ghana EPA and IFC PS4 requirements. Noise related complaints.	Verbal and documented feedback from construction workers and neighbouring communities.	Throughout construction and decommissioning phase.
Construction and operation (Stage 1a)	Noise impacts to nearby commercial worker accommodation during Stage 1a	Implementation of the mitigation solution ultimately agreed with the adjacent commercial premises to manage Stage 1a noise impacts.	EPL EPC Contractor(s).	Ghana EPA and IFC PS requirements	EPL to undertake regular consultation with the adjacent commercial businesses during Stage 1a to confirm noise levels are within acceptable limits. Outcomes to be recorded as required.	Throughout Stage 1a.
<b>Water and Wastewater</b>						
Construction and decommissioning	Protection of local watercourses	Construction and decommissioning phase impacts on the local water environment will largely be controlled through the application of GIIP construction methodology, including the adoption of the requirements of WBG / IFC General EHS Guidelines. This will include management of construction site drainage and appropriate sediment segregation / run off controls and appropriate control and storage of potential pollutants such as fuels or cementitious material used in the construction process.	EPC contractor(s).	Ghana EPA and IFC requirements.	Site inspection	Throughout construction and decommissioning period.
Construction and decommissioning	Wastewater contamination	Chemically treated wastewater from hydrostatic testing of storage tanks and pipelines will be minimised by pre-use tests to determine whether simple pH adjustment is sufficient. This would avoid the need for more environmentally aggressive chemicals. The project also intends to avoid the use of dyes (e.g. fluorescein) in the test water. All discharges (including concentration of biofouling additives if required) will be assessed to ensure that the quality standards stated in Tables 16-1 are met. Wastewater that cannot meet the quality requirements will be removed from site by tanker and disposed of at an appropriately licensed facility.  Sanitary wastewater will be collected in a series of septic tanks, which will be emptied on a regular basis. An authorized contractor will be assigned the responsibility of emptying the septic tanks and disposing of the wastewater in accordance with legal requirements.  Provision will be made for sufficient number of toilets to accommodate the number of workers present at any given time. Site rules will be implemented to ensure that workers use the facilities provided to avoid uncontrolled release of pollutants into the environment.	EPC contractor(s).	Ghana EPA and IFC PS 3 and 4 requirements.	Compliance with HSSE management plans for management of wastewaters.  Monitoring of wastewater facilities as part of routine site inspections. Monitoring of wastewaters generated by visual inspection and laboratory testing (as applicable).	Throughout construction and decommissioning period.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
Construction and decommissioning	Contamination of groundwater sand surface waters following spillages.	All workers will be trained in the handling, storing, and disposal of hazardous materials. Emergency procedures will be in place so that in the event of an accidental release the spill can be contained and effects mitigated. Emergency spill containment material and clean-up equipment will be distributed and stored in appropriate places so that any spill can be cleared up as quickly as possible to minimize any adverse effects.	EPC contractor(s).	Ghana EPA and IFC PS 3 and 4 requirements.  Site inspection records.	Regular site inspections to monitor conditions.	Throughout construction and decommissioning period.
Operation	Accidental spills of fuel, etc. could cause contamination of water resources.	As in construction, there is the possibility that accidental spills of fuel, etc. could cause considerable contamination of watercourses. GIIP precautions including adoption of the requirements of WBG/ IFC General EHS Guidelines will be utilised to prevent accidents. Oil and fuel areas will be bunded. All workers will be trained in the handling, storing, and disposal of hazardous materials. In the event of an accidental release there will be emergency procedures in place so that the spill can be contained immediately. Emergency spill containment material and clean up equipment will be distributed and stored in appropriate places so that any spill can be cleared up as quickly as possible to minimize any adverse effects.  Any contaminated waste waters / storm waters following a spill, will be collected as far as possible and retained on site prior to being treated by the waste water treatment system or appropriate off-site treatment system and discharged.	Plant operator(s) to develop and implement appropriate HSSE plans to management and mitigate risks for accidental spills, include appropriate emergency response and spill plans. .	Ghana EPA and IFC requirements.	Visual inspection, in routine site audits of watercourses to visually check for signs of contamination.	Prior to operation. Implementation of emergency response / spill response in event of an incident.  Throughout operational lifetime of the project.
Operation	Wastewater Treatment	The project includes a waste water treatment plant which will treat the process wastewater to control the concentrations of various compounds to within the limits prescribed by the Ghana EPA and IFC. The resulting effluent will then be discharged via storm drains into the adjacent stormwater drainage system. Appropriate monitoring arrangements will be put into place to ensure that discharge effluent complies with the Ghana and IFC discharge quality standards.  Sanitary wastewater will be removed from site by tanker for off-site treatment and discharge.	Plant operator(s) in the appropriate treatment / disposal of contaminated waters.	Ghana EPA and IFC PS 3 requirements.	Appropriate monitoring as per HSSE plans and routine site audits.	Throughout operational lifetime of the project.
<b>Terrestrial Ecology</b>						
Construction	Direct impacts on species on-site	<ol style="list-style-type: none"> <li>1. If possible, the construction work should begin during the dry season when a number of species are likely to be absent.</li> <li>2. Carry out clearance activities outside the breeding season. On Power Plant Site 2, undertake clearance right after the farming activities before natural vegetation grows back.</li> <li>3. The neem tree present on site should not be encouraged to spread. The EPC contractor should include measures to prevent this in the construction phase.</li> <li>4. The disposal of the tree and any seeds should be done with care and certain pesticides can be used to support the eradication of the plant; and,</li> <li>5. The population of the chaff flower should be monitored. The chaff flower is of conservation importance and should be preserved where possible.</li> </ol>	EPC Contractor (s).	Ghana EPA and IFC PS 6 requirements.	Visual inspection.	Throughout construction period.
Construction, operation and decommissioning.	Release of contaminants causing damage to ecological receptors.	<ol style="list-style-type: none"> <li>1. As per provisions for maintaining land quality.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	Ghana EPA and IFC PS 6 requirements.	Monitoring as per provisions for maintaining land quality.	Throughout the life of the project.
<b>Labour, Workforce, Community Health, Safety and Security</b>						

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
Construction, operation and decommissioning	Discrimination within the workplace (based on gender, culture, age etc.) including with regards to employment opportunities for local communities.	<ol style="list-style-type: none"> <li>1. Ensure a transparent hiring process is conducted help the community to understand strategic staffing decisions for the project to avoid conflict.</li> <li>2. Develop a training and skills programme, to impart good international industry practice in the skilling of local people for construction and operational jobs.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	Requirements of IFC Performance Standard 2.	<p>Monitoring and evaluation of success EPL training programme</p> <p>Implementation and monitoring of an appropriate workers grievance mechanism.</p>	Throughout the lifetime of the project.
Construction, operation and decommissioning	Exploitation of workers and contractors.	<ol style="list-style-type: none"> <li>1. Comply with national law and IFC PS 2 requirements regarding workers' rights to join organisations for workers of their choosing and to allow workers to elect representatives.</li> <li>2. Measures to be taken to prevent and address any harassment, intimidation and exploitation in the workplace.</li> <li>3. Implementation of an appropriate grievance mechanism for workers to raise workplace concerns.</li> <li>4. Neutral workers representations should be made available for all staff to voice complaints and concerns.</li> <li>5. Ensure there is no forced labour.</li> <li>6. Ensure contractors have access to a grievance mechanism.</li> <li>7. Implement policies on the quality and management of the accommodation offered to workers.</li> <li>8. Ensure implementation of appropriate occupational, health, safety management plans and systems for all staff. Loss time incident reports to be monitored for any abnormal / regular occurrences, which may need to be addressed.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	Ghana national law and requirements of IFC Performance Standard 2.	<p>Human Resources (HR) management systems to include the monitoring and document details of all workers and contractors.</p> <p>Reporting of any incidents to be documented and monitored to enable appropriate action to be taken.</p> <p>Implementation and monitoring of an appropriate workers grievance mechanism.</p> <p>Regular review of lost time incident reports.</p>	Throughout the lifetime of the project.
Construction, operation and decommissioning	Use of in appropriate child labour and exploitation of children.	<p>Children are not to be employed in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.</p> <ol style="list-style-type: none"> <li>1. Applicable Ghanaian laws in child labour to be adhered to.</li> <li>2. Children under the age of 18 are not to be employed in hazardous work.</li> <li>3. Appropriate risk assessment and regular monitoring of health, working conditions, and hours of work for all children under the age of 18 to be undertaken.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	Ghana labour law and requirements of IFC Performance Standard 2.	<p>Human Resources (HR) management systems to include the monitoring and documentation of staff recruitment and details of staff employment terms and conditions.</p> <p>Reporting of any incidents to be documented and monitored to enable appropriate action to be taken.</p>	Throughout the lifetime of the project.
Construction, operation and decommissioning	Unfair dismissal of workers.	<ol style="list-style-type: none"> <li>1. Ensure that all workers receive notice of dismissal and timely severance payments mandated by law and any outstanding back pay and social security benefits and pension contributions</li> <li>2. Carry out an analysis of alternatives to retrenchment prior to implementing any dismissals.</li> <li>3. Where there are no alternatives to retrenchment development and implementation of a retrenchment plan to be undertaken. The retrenchment plan is to be based on the principle of non-discrimination and will follow consultation with workers, their organizations, and, where appropriate, the government. It is to be compliant with collective bargaining agreements, legal and contractual requirements related to</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	National laws and requirements of IFC Performance Standard 2.	Human Resources (HR) management systems to include the monitoring and documentation of dismissals and their circumstances.	Throughout the lifetime of the project.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		notification of public authorities, and provision of information to, and consultation with workers and their organizations				
Construction, operation and decommissioning	Workers exposed to unsafe working conditions.	<ol style="list-style-type: none"> <li>1. Compilation and implementation of health and safety systems and management in addition to environmental management.</li> <li>2. Potential hazards to be identified and provision of appropriate management and mitigation measures to be used. An engineering "constructability review" should be conducted to determine safe working practice for installation of the new above ground pipe within the TOR pipeline corridor.</li> <li>3. Preventative and protective measures to be implemented where necessary. Workers to have access to appropriate personal protective equipment (PPE) at all times.</li> <li>4. EPL to monitoring any construction works undertaken by other parties on behalf of EPL, e.g. construction of the main water supply pipeline by Ghana Water Company. Monitoring to include environmental parameters in addition to worker and community health and safety.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	National law and requirements of IFC Performance Standard 2.	Continued monitoring, reporting and documentation of any incidents.	Throughout the lifetime of the project.
Construction, operation and decommissioning	Injury or harm to site workers / communities as a result of badly designed plant and construction / decommissioning management.	<ol style="list-style-type: none"> <li>1. The designing, construction, operation, and decommissioning of the structural elements or components of the project to be in accordance with industry best practice.</li> <li>2. Use of competent personnel in design and construction.</li> <li>3. Design and construction to consider safety risks to third parties or Affected Communities as well as project workers.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	National law and requirements of IFC Performance Standard 2 and 4.	Continued monitoring, reporting and documentation of any incidents.	Throughout the lifetime of the project
Construction, operation and decommissioning	Injuries to workers / communities as a result of transportation of deliveries and exported good on surrounding roads.	<ol style="list-style-type: none"> <li>1. Mitigation measures as specified in section on traffic and transport. Measures include routing of loads away from sensitive receptors and timing of deliveries to avoid busy periods.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	National law and requirements of IFC Performance Standard 2 and 4.	Continued monitoring, reporting and documentation of any incidents.	Throughout the lifetime of the project.
Construction, operation and decommissioning	Community Safety	<ol style="list-style-type: none"> <li>1. A Construction Management Plan and procedures shall be prepared by the EPC Contractor to help to minimise land and community disturbance and associated safety risks.</li> <li>2. Consider contributing to community improvement projects in the local area including community beautification and infrastructure improvement.</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	National law and requirements of IFC Performance Standard 2 and 4.	Continued monitoring, reporting and documentation of any incidents.	Throughout the lifetime of the project.
Construction, operation and decommissioning	Pipeline safety	<ol style="list-style-type: none"> <li>1. The project will be developed in line with Onshore O&amp;G EHS guidelines. The proposed pipeline shall be coated and for the underground pipework, use cathodic protection to prevent corrosion and with SCADA. The depth of the pipeline shall be defined to ensure protection. Also the wall thickness should be redundantly designed (F factor redundancy).</li> <li>2. Work with TOR, TMA and TDC to encourage development of a pipeline safety management plan including pipeline markers to be installed to identify the pipeline rights-of-way, but not the exact location of the underground location; community awareness campaigns; and development of protections (crash barriers, guard posts and signage) on the road crossings.</li> <li>3. The project should obtain and review all TOR environmental management and emergency planning documentation, including fire</li> </ol>	EPL. EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	National law, IFC PS 2 and 4 and relevant WBG / IFC EHS Guidelines.	<p>Recording of reported incidents during the construction, operation and decommissioning of the pipeline. Any incidents to be recorded by</p> <p>Site health, safety stats to be regularly reviewed.</p> <p>Review of TOR documentation and updated iterations</p>	Throughout the lifetime of the project.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		<p>and spill response and control at both TOR and the TOR jetty. Where any gaps are identified, these the project should engage with TOR in order to advocate for progressive improvements in the documentation.</p> <p>4. An engineering “constructability review” should be conducted to determine safe working practice for installation of the new above ground pipe within the TOR pipeline corridor.</p>				
Construction, operation and decommissioning	Community Safety and Security	<ol style="list-style-type: none"> <li>1. A Transport Management Plan shall be implemented for any construction traffic to reduce the potential for accidents.</li> <li>2. Project Sponsor will consider contributing to infrastructure improvements in the community specifically targeting community beautification efforts and traffic calming measures.</li> <li>3. All project operations vehicles and contractor vehicles will have a speed limit set for travel through settlements and areas where there are no posted speed limits.</li> <li>4. A Worker Policy and Code of Behaviour shall be developed which includes guidance on visits, prescribed actions for conduct violations and a grievance mechanism for complaints.</li> <li>5. The EPC contractor shall involve external stakeholders (i.e. police or local authorities) in any on or off-site security incidents and ensure that appropriate incident response procedures are implemented.</li> <li>6. An HIV/AIDS awareness and prevention program shall be implemented to provide the community with tools and education materials to reduce the spread of HIV/AIDS.</li> <li>7. An important aspect of minimising the spread of communicable diseases within the community is worker health screening, particularly as many workers are local people. A worker health screening programme shall be developed and implemented during the peak construction period or at any time when workers on site number more than 100.</li> <li>8. First Aid and Safety training will be provided to workers and Community Emergency Response Plans will be developed and tested including workers and nearby residents in the vicinity of Project-related traffic. These will include emergency response related to traffic accidents and potential releases of chemicals and other hazardous materials.</li> <li>9. A Fire Prevention and Response Plan will be developed as part of the Emergency Response Plans. This will set out measures to minimise the potential for fire / explosion to occur, and provide a set of procedures to be implemented should such an event occur.</li> </ol>	EPC contractor(s). Plant operator(s). Decommissioning contractor(s).	National laws and IFC PS 3 and 4	<p>Implementation of actions and monitoring of reporting associated with actions.</p> <p>Monitoring of health and safety statistics and site lost time incident reports.</p>	Throughout the lifetime of the project.
Construction	Appropriate workers accommodation and management within the community.	<ol style="list-style-type: none"> <li>1. Whilst currently not anticipated, any temporary worker accommodation plans if required in future will be developed according to international requirements specified within the EBRD / IFC Workers Accommodation Guidelines. Workers within the community will be managed in line the requirements of IFC PS 4.</li> </ol>	EPC contractor(s).	EBRD / IFC Workers Accommodation Guidelines. IFC PS 2 and 4.	<p>Audit of workers accommodation during construction activities demonstrates compliance with the guidelines.</p> <p>Implementation of appropriate community management plans.</p>	Throughout construction
<b>Solid Waste</b>						
Construction, operation and decommissioning	Potential to harm human health and environment through uncontrolled disposal of wastes.	An Environmental Control Officer / Manager (title to be confirmed) will be appointed to ensure the management systems are implemented correctly.	EPC contractor(s) (s). Plant operator(s).	Ghana EPA and IFC requirements.	Visual inspection and maintenance of site inspection records.	Throughout the lifetime of the project.

Project Phase	Environmental Aspect and Identified Impacts	Action / Mitigation Measures	Responsible Party	Applicable Standard(s) / recommended basis of assessment/ KPI	Monitoring Requirement(s) / Recommended Monitoring	Time Frame
		<p>Detailed waste management procedures will be developed for the operational phase in accordance with the requirements of the Waste and Environmental Management Plans.</p> <p>Permanent segregation facilities will be provided (e.g. separate receptacles for food wastes, plastics, metals). The receptacles will be clearly marked and suitable to hold the type of waste they will contain. There will be frequent emptying of waste receptacles and transfer to appropriate storage facilities on site and/ or transfer and disposal by suitable waste disposal contractors.</p> <p>Waste storage will be within designated areas located on hard surfacing and covered where appropriate to ensure containment and prevent ingress of rain. There will be special provisions for the storage of any hazardous wastes and these will be segregated from non-hazardous wastes.</p> <p>All storage areas will be regularly emptied and periodically cleaned and disinfected.</p> <p>Staff will be fully trained in the handling and suitable disposal of waste streams and provided with PPE where appropriate.</p>	Decommissioning contractor(s).			
<b>Traffic and Transport</b>						
Construction and decommissioning	Risk of accidents and congestion.	<p>Speed limits to be imposed on vehicles travelling through sensitive areas, e.g. near schools</p> <p>Roads and embankments to be strengthened as necessary to ensure they are adequate for safe transportation of HGVs.</p> <p>Access roads to be developed prior to construction/ demolition, ensuring they are adequate for safe use by construction vehicles.</p> <p>Transport routes to be agreed with planning authority.</p> <p>Schedule transport movements(particularly HGV movements) to avoid peak transport movements associated with adjacent power stations and local communities (mitigate against cumulative impacts).</p> <p>Emergency response plan for road traffic incidents to be prepared and implemented.</p>	EPC contractor(s) (s). Plant operator(s). Decommissioning contractor(s).	Ghana EPA and IFC requirements.	Monitoring and report of traffic incidents to be reviewed regularly. Corrective actions implemented in event of incidents.	Throughout the lifetime of the project.
<b>Landscape and Visual</b>						
Post-construction / pre and during operation	Visual amenity of the power plant and tank farm.	Landscaping of the site upon completion of construction works. This will both mitigate visual impact and reduce erosion from any surface waters during heavy rains and flood periods Soils excavated during construction could be used for landscaping if suitable.	EPC contractor(s) and Plant operators (s)	N/A	Visual inspection.	Post-construction. Maintenance of landscaped areas may be required in operational period.

## 2.1 Decommissioning

### 2.1.1 Overview

The project will be designed for an operational life of at least 25 years. At the end of its life, the project will be decommissioned and the sites reinstated as agreed with the relevant authorities. Decommissioning will take account of the environmental legislation and the technology available at the time. Prior to any decommissioning of the plant, the Ghana EPA will be notified and an assessment will be carried out to identify any environmental impacts that need to be mitigated in the decommissioning process. Any necessary licences or permits will be acquired.

This following presents the process of decommissioning for the project at the end of construction and end of the project life cycle. Detailed decommissioning plans will be developed by relevant contractors / site operators at the time of decommissioning. These plans can be submitted to the EPA for review as relevant.

### 2.1.2 Legal Requirements

The major legal requirements include the Ghana equivalent to the UK Health and Safety at Work Act 1974 and Construction (Design and Management) Regulations with its associated Construction Phase Health and Safety Plan.

Any reputable demolition contractor should also be accredited to the Ghana equivalent to the UK BS EN ISO 14001 (Environmental Accreditation) and BS EN ISO 9001 (Quality Standard).

As part of the Contractor's safety procedures to ensure compliance with all relevant legislation, unique Method Statements and Risk Assessments will be prepared and be available for inspection by all parties together with being issued and adhered to by the relevant site demolition operatives.

### 2.1.3 Decommissioning – General

The design life of the major project equipment to be used will be a nominal 25 years; however it is not uncommon for projects such as the proposed development to operate for 40 years or more. The decision to decommission the project will be depend on its economic viability with regards to fuel costs, plant life and environmental requirements.

The costs of decommissioning will be borne by the operator and are usually covered by the recycling value of certain items of plant.

Decommissioning will take account of the environmental legislation and the technology available at the time. Notice will be given to the EPA through a Decommissioning Plan in advance of the commencement of the decommissioning work. Any necessary licences or permits would be acquired.

The operator will develop a decommissioning plan and the works will be undertaken in accordance with an ESMP, which would cover safety and environmental issues and would be agreed with the relevant authorities not less than 12 months prior to commencement of decommissioning.

A fully detailed and accurate register of all external service connections to and from the project and will be compiled by the operator staff prior to decommissioning. The register must be available to support the formulation of a structured decommissioning programme in accordance with a Site Decommissioning Procedure. The documentation and drawings systems at the project sites will contain all the necessary information to produce a dedicated register for demolition purposes.

#### **2.1.4 Decommissioning - Managing Environmental Aspects**

This Section provides specific guidance on prevention and control of environmental, community health and safety impacts that may occur during the decommissioning activities at the end of the construction period and at the end of the project life-cycle. Many of the following discussion points are presented as actions within the ESMP tables above, which should be read in conjunction with this Section.

##### **Noise and Vibration**

During decommissioning activities, noise and vibration may be caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. The following noise reduction and control strategies will be used to minimise impacts at nearby communities:

- Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance.
- Using noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines.
- Avoiding or minimizing project transportation through community areas.

##### **Soil Erosion**

Soil erosion may be caused by exposure of soil surfaces to rain and wind during site clearing, earth moving, and excavation activities. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the quality of natural water systems and ultimately the biological systems that use these waters.

The following soil erosion and water system management approaches will be considered:

##### ***Sediment mobilization and transport***

- Reducing or preventing erosion by:
  - Scheduling to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical.
  - Contouring and minimizing length and steepness of slopes.

- Mulching to stabilize exposed areas.
- Re-vegetating areas promptly.
- Designing channels and ditches for post-construction flows.
- Lining steep channel and slopes (e.g. use jute matting).
- Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical.

#### ***Clean runoff management***

- Segregating or diverting clean water runoff to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release.

#### ***Road design***

- Limiting access road gradients to reduce runoff-induced erosion.
- Providing adequate road drainage based on road width, surface material, compaction, and maintenance.

#### ***Disturbance to water bodies***

- Depending on the potential for adverse impacts, installing free-spanning structures (e.g., single span bridges) for any road watercourse crossings.
- Consider using trenchless technology for pipeline crossings (e.g., suspended crossings) or installation by directional drilling.

#### ***Structural (slope) stability***

- Providing effective short term measures for slope stabilization, sediment control and subsidence control until long term measures for the operational phase can be implemented.
- Providing adequate drainage systems to minimize and control infiltration.

#### **Air Quality**

Decommissioning activities may generate emission of fugitive dust caused by a combination of on-site excavation and movement of earth materials, contact of machinery with bare soil, and exposure of bare soil and soil piles to wind. A secondary source of emissions may include exhaust from diesel engines of earth moving equipment, as well as from open burning of solid waste on-site. The following

techniques will be considered for the reduction and control of air emissions from construction and decommissioning sites include:

- Minimizing dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (water suppression, bag house, or cyclone).
- Minimizing dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content.
- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements.
- Selectively removing potential hazardous air pollutants, from existing infrastructure prior to demolition.
- Avoiding open burning of solid.

### **Solid Waste**

Non-hazardous solid waste generated at decommissioning sites includes excess fill materials from grading and excavation activities, scrap wood and metals, and small concrete spills. Other non-hazardous solid wastes include office, kitchen, and dormitory wastes.

Hazardous solid waste includes contaminated soils, which could potentially be encountered on-site due to previous land use activities, or small amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil, as well as spill clean-up materials from oil and fuel spills. Techniques for managing solid wastes are presented in the ESMP tables above.

### **Hazardous Materials**

Decommissioning activities may pose the potential for release of petroleum based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. These materials may also be encountered during decommissioning activities in building components or industrial process equipment. The following techniques for prevention, minimization, and control of these impacts will be considered:

- Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids.
- Using impervious surfaces for refuelling areas and other fluid transfer areas.
- Training workers on the correct transfer and handling of fuels and chemicals and the response to spills.

- Providing portable spill containment and clean-up equipment on site and training in the equipment deployment.
- Assessing the contents of hazardous materials and petroleum-based products in building systems and process equipment and removing them prior to initiation of decommissioning activities, and managing their treatment and disposal.
- Assessing the presence of hazardous substances in or on building materials and decontaminating or properly managing contaminated building materials.

### **Wastewater Discharges**

Decommissioning activities may include the generation of sanitary wastewater discharges in varying quantities depending on the number of workers involved. Adequate portable or permanent sanitation facilities serving all workers should be provided at all sites.

### **Contaminated Land**

Land contamination may be encountered in sites under decommissioning due to known or unknown historical releases of hazardous materials or oil, or due to the presence of abandoned infrastructure formerly used to store or handle these materials, including underground storage tanks.

Actions necessary to manage the risk from contaminated land will depend on factors such as the level and location of contamination, the type and risks of the contaminated media, and the intended land use. However, a basic management strategy, if encountered, will include:

- Managing contaminated media with the objective of protecting the safety and health of occupants of the site, the surrounding community, and the environment post construction or post decommissioning.
- Understanding the historical use of the land with regard to the potential presence of hazardous materials or oil prior to initiation of construction or decommissioning activities.
- Preparing plans and procedures to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment.
- Preparation of a management plan to manage obsolete, abandoned, hazardous materials or oil.

#### **2.1.5 Decommissioning**

The first step of decommissioning will be to make the plant safe for work in accordance with relevant safety procedures. The power station would be de-energised in conjunction with the VRA. Stored materials would be sold where possible or disposed of off-site by a licensed contractor. Storage

tanks and pipes would be emptied and cleaned. Closed vessels, pipes and other areas which could have hazardous gases present would be vented in accordance with normal operating procedures. These would then be tested to ensure that they are safe for removal or entry.

Once the plant is completely disconnected, and all hazardous materials removed, it will be handed over to a competent contractor (or contractors) to complete the dismantling and demolition work.

It is probable that most of the plant and equipment will be at the end of its useful operating life and will be obsolescent or obsolete and unsuitable for further use. It will therefore need to be dismantled for recycling, where it is economic to do so. Unsalvageable material will be disposed of at a licensed landfill. Any remaining aqueous effluents would be disposed of in accordance with the normal operating licence or as agreed with the regulatory authorities.

Site buildings and structures would be removed to permit the future use of the two sites. Soils would be remediated to the agreement of the EPA.