PROPONENT:
DAIMA GAS LIMITED
P O BOX 56168-00200
NAIROBI

PROPOSED 50 METRIC TONNE L.P.G. STORAGE AND BOTTLING FACILITY IN WANJARE SOUTH LOCATION, BOKEIRE SUBLOCATION ON PLOT NO. WANJARE/BOKEIRE/5131 & WANJARE/BOKEIRE/3042 IN SUNEKA, KISII COUNTY

Environment Impact Assessment Study Report

NEMA REFERENCE: NEMA/PR/5/2/20370-PSR12089

NOVEMBER 2018

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Table 1

ACKNOWLEDMENT
The Experts take this opportunity to thank the project Proponent Mr. Adan Ali director of **Daima Gas Limited** for giving us a chance to conduct this Environmental Impact Assessment (EIA). This was done in an endeavor to comply with the Legal requirement as stipulated in section 58 of the Environmental Management and Co-ordination Act (EMCA) of 1999 legal Notice No.8.Sincere thanks to our client for availing the necessary documentation and facilitating the site visits to enable the expert and his team to effectively carry out the EIA, and to R&E Modern Technologies for giving us technical support on the specifications of the project. We would also like to thank all the participants who took their time to listen to us and filled out the questionnaires, Mr. George Miruka and the area chief for helping in mobilizing locals to participate in public consultations.

ACRONYMS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
BD	Biodiversity
C	Celsius
CBD	Convention on Biodiversity
CGK	County Government of Kisii
CO	Carbon Monoxide
CO2	Carbon Dioxide
DG	Diesel Generator
DOHS	Director of Occupational Health and Safety Services
EA	Environmental Audit
EMCA	Environmental Management and Co-ordination Act, 1999
EMP	Environmental Management Plan
ERC	Energy Regulatory Commission
EHS	Environmental, Health and Safety
F	Fahrenheit
GHG	Greenhouse Gas
GOK	Government of Kenya
HSD	High Speed Diesel
Ha	Hectares
I&AP	Interested and affected parties
ISO	International Standard Organization
KES/Kshs	Kenya Shillings
LDAR	Leak Detector and Repair
LPG	Liquefied Petroleum Gas
MT	Metric Tonne
m	Meters
NCA	National Construction Authority
NEAP	National Environmental Action Plan
NEMA	National Environmental Management Authority
NFPA	National Fire Protection Association
NOx	Nitrogen oxide
O_3	Ozone
GWASCO	Gusii Water and Sewerage Company
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Act
PPEs	Personal Protective Equipments
QRA	Quantitative Risk Analysis
TOR	Terms of reference
WRMA	Water Resources Management Authority

DEFINITION OF TERMS

Aboveground tank or aboveground vessel: a tank or vessel all or part of which is exposed above grade.
Auto refrigeration: the chilling effect of vaporization of LPG when it is released or vented to a lower pressure.
Boiling-liquid expanding-vapor explosion (BLEVE): the phenomenon of a pressurized LPG tank failing such as can occur from direct exposure to a fire (normally a catastrophic event).
Installations: tanks, vessels, pumps, compressors, accessories, piping, and all other associated equipment required for the receipt, transfer, storage, and shipment of LPG.
Liquefied petroleum gas (LPG or LP-gas): any material in liquid form that is composed predominantly of any of the following hydrocarbons or of a mixture thereof: propane, propylene, butanes (normal butane or isobutane), and butylenes.
Mounded tank or mounded vessel: a tank or vessel located above or partially above the general grade level but covered with earth, sand, or other suitable material.
Refrigerated storage: storage in a vessel or tank artificially maintained at a temperature below the nominal ambient temperature.
Rollover: the spontaneous and sudden movement of a large mass of liquid from the bottom to the top surface of a refrigerated storage reservoir due to an instability caused by an adverse density gradient. Rollover can cause a sudden pressure increase and can affect vessel integrity.
Tank or vessel: a container used for storing LPG.
Underground tank or underground vessel: a tank or vessel all parts of which are completely buried below the general grade of the facility.
Braided: A layer (or layers) of cylindrically woven wires covering the hose and attached to the hose ends and fittings, serving the functions of:
a) restraining the hose against elongation; and
b) damping vibration of the hose.
Competent person : A person with knowledge, training and ability to carry out their work safely and with the necessary proficiency to ensure the subsequent safe operation of the equipment.
Enforcing authority: The authority responsible for enforcing national and local relevant statutory requirements. (Can either be a national body or a local authority).
Evaporation area : Safe ground adjacent to LP Gas storage tank(s) where LP Gas can evaporate and disperse safely.
Fire wall: A screen, wall, or dividing partition set up in open air to protect LP Gas tanks, pipes or equipment from radiated heat and to ensure enough dispersion distance in the event of a leak from a protected tank.
Fire resisting: The ability of materials to resist a fire for specific periods of time, if tested from either side, whilst still retaining properties of insulation, integrity and stability.
Non-combustible: Material which will not support combustion when tested in accordance with recognized standards.
Point of liquid transfer: The point at which liquid transfer connections and disconnections are made.
Remotely operated emergency shutdown valve: A shut-off valve that can be activated remotely to automatically shut when engulfed by fire, deprived of actuating power or some other hazardous condition is detected.
Separation distance: The horizontal distance between a specified feature and the nearest part of a storage tank.

EXECUTIVE SUMMARY

INTRODUCTION

Daima Gas Limited is an upcoming LPG dealer in Kenya, which is hereinafter referred to as Proponent, incorporated under the Companies Act (Cap. 486) *(see company registration in appendix 1).* The company is proposing to install 50 cubic meters of LPG storage and filling plant in Wanjare South location, Bokeire sub-location on Plot No. WANJARE/BOKEIRE/5131 & WANJARE/BOKEIRE/3042 in Suneka, Kisii County GPS coordinates **Latitude:-0.6933991005644202, Longitude: 34.69036496244371**. *(see Lease agreement in appendix2)*.

The Legal Notice No. 101 of 2003 (EIA/EA Regulations, 2003) requires the Proponent to prepare EIA Study Report for approval by National Environment Management Authority (NEMA) prior to commencement of a new development. As such, Daima Gas Limited engaged Erick Abuga, (EIA/EA Lead Expert NEMA Reg. 2675) *(See expert license in appendix 3)* to undertake environmental impact assessment for the proposed project.

BACKGROUND

An EIA Project Report for the said project was submitted on 28th September 2018 to NEMA head office along Popo road in Nairobi (NEMA Ref:NEMA/PR/5/2/20370-PSR12089) and the initial review of the report revealed that the magnitude and risks associated with the proposed project demand wider public consultation and in-depth coverage of the foreseen impacts and mitigation measures.

Pursuant to section 58 of the Environmental Management and coordination Act Cap 387 and regulation 10 of the Environmental (Impact Assessment and Audit) regulations, 2003 Legal notice 101 the proponent was asked to initiate an Environment Impact Assessment study to facilitate in-depth evaluation of potential impacts associated with the proposed project and to enhance consultations with the affected and interested stakeholders.

NEED AND JUSTIFICATION FOR THE ENVIRONMENT IMPACT ASSESSMENT

The aim of this EIA study is to assess the environmental impacts associated with the design, construction and operation of the planned L.P.G. plant. The EIA proposes practical and effective mitigation measures to prevent/reduce any potential negative implications of the construction and operation of the proposed L.P.G. filling plant. In addition, an environmental management plan has been developed to ensure best environmental performance. The EIA is based on the following:

- Environmental impacts associated with the project
- Examination of environmental and social impacts including factors that impact public health and safety as well as the natural environment, such as: air, water, soil, waste, accidents, water usage, ecosystems, and biota. Other concerns examined include: landscape, communicable diseases, etc.
- In addition to the direct and immediate impacts, derivative, secondary and cumulative impacts were also examined and investigated to a reasonable extent.

- Alternative proposals and/or minimization measures to prevent or reduce adverse impacts have been examined to choose a better project option in terms of environmental considerations. In examination of measures, priority was given to the prevention of environmental impact, and mitigation measures were considered and incorporated in the plan.
- Examination of the environmental and social considerations included analysis of environmental costs and benefits in quantitative terms, as much as possible, while taking into consideration economic, financial, institutional, social and technical aspects.
- Appropriate follow-up environmental management and monitoring plans have been prepared as part of the EIA. Estimated costs of implementing such plans and financial resources to cover such costs have been estimated.

The relevant laws, regulations and policy frameworks have also been considered.

Terms of reference

According to the Terms of Reference, the following tasks were completed during the preparation of this EIA study report for the proposed LPG filling plant:

- Conducted visits, to the site for the purpose of site reconnaissance and established updated baseline and collected data from the local concerned stakeholders;
- Reviewed all relevant laws and regulations relevant to the planned activities;
- Described the environmental and social settings for the areas where the planned LPG facility will sit;
- Assessed the potential positive and negative environmental impacts associated with the planned activities ;
- Assessed risks and hazards associated with the project activities
- Prepared a comprehensive Environmental Management Plan (EMP)
- Undertook public consultations.
- Developed an effective plan to ensure effective and efficient implementation of the proposed environmental management and monitoring activities.

APPROACH

The Consultants identified and compiled all readily available technical data and information that has been used to this EIA study report. Appropriate and justified engineering/scientifically based assumptions were made to cover any information or data gaps.

In preparing the Environmental Impact Assessment the Consultants ensured compliance with:

- Current environmental regulations, laws and standards of Kenya.

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Objective and methodology

The objective of the EIA is to examine the environmental, economic, physical, and biological impacts in the areas which may be affected by the project, and to propose

mitigation measures. The main sections of the EIA include definition of the legal and institutional frameworks, description of the project and the environment, impacts assessment, identification of mitigation measures, and presentation of an environmental management plan (EMP).
The study was based on laid down scientific qualitative procedures with most recent methodologies and analysis required in EIA studies and strictly adhered to relevant legislative framework governing the industrial sector.
Our investigation examined the potential impact of the project on the immediate surroundings with due regard to all project phases from construction, operation and decommissioning. The instruments used in the EIA study consisted of questionnaires, a camera and GPS equipment.
The methods for obtaining data included; Administering of questionnaires, site reconnaissance and visual survey to determine the baseline information of the project area, comparative report of the project with existing land uses in the neighbourhood, analysis of the project documents that include equipment design, land documents and discussion with the proponent by the consultant. The expert also undertook an effective consultation where issues of concern and interest to the neighbours, members of the public and stakeholders were raised, discussed and documented. The proponent's commitment to continuous consultation is important and the expert wishes to acknowledge the work of the proponent and the neighbours in identifying relevant issues and responding in a constructive manner. The proponent has also committed to address any key issues that might emerge during the operation phase of the project.

Legal and Institutional Framework
An overview of the key environmental, health & safety legislation and regulations relevant to each project component were taken into account during the EIA exercise. The most relevant regulations considered during the assessment are the Policy Framework, Environment Management and Coordination Act (EMCA), 1999, The Water Act 2002, Public Health Act, Energy Act,2006, Physical Planning Act, 1999, Occupational Safety and Health Act, 2007, Environmental (Impact Assessment and Environmental Audit) Regulations, 2003, Waste Management Regulations 2006, Water Quality Regulations 2006, Conservation of Biological Diversity (BD) Regulations 2006, Fossil Fuel Emission Control Regulations 2006 and Noise and Excessive Vibration Pollution Control Regulations, 2009.
Based on these regulations, a control framework has been established to guarantee that minimum standards for water resources, air, health & safety are established as well as protection of the environmental resources potentially affected by the project is ensured.
In addition international conventions and treaties governing conservation of biodiversity and control of greenhouse gases emissions have been considered, and their relevance to each of the components assessed.

Impact assessment and mitigation
This study assessed the potential impact/s of the proposed development on the receiving environment (natural and social). The report evaluates issues and concerns

raised by Interested & Affected Parties (I&AP) and assesses the significance of the potential impacts on the natural and social environment.
Various potential impacts in different significance are anticipated during either construction and/or operation.
Possible impacts on soil, water resources, human amenity, occupational and public health hazards, traffic, noise levels, dust, exhaust emissions; waste water disposal, solid waste disposal and visual impact are anticipated if compliance standards are not met as set by the relevant authorities. However an assessment of impacts indicated that these negative impacts will not be significant as long as mitigation measures are continuously and adequately implemented.
On the other hand, positive impacts are directly beneficial and are the key goals in the implementation of the project.
Several environmental and social issues and concerns were raised at the public consultation and participation. The residents raised some genuine environmental issues and it was noted that the underlying issue was mainly the collection and disposal of solid waste which is poor in most parts of the town including the project site area.

Conclusion

The EIA report presents the findings of the assessment which include an Environmental Management Plan (EMP) and fulfils the requirements of EMCA 1999. The policy, legal and institutional framework described in this report relates to the industrial sector in Kenya.
Following the assessment; none of the possible impacts are regarded as having major significant impact to the extent that the intended activity cannot proceed and given that mitigations and recommendations proposed can be implemented and monitored.

1.0 INTRODUCTION

1.1 Background

The EIA Study has been undertaken to fulfil the legal requirements of the Environmental Management and Co-ordination Act (EMCA) 1999 and the Environmental (Impact Assessment and Audit) Regulations 2003.

1.2 Objectives of EIA Study

The specific objectives of the EIA study are to:

- Collect and analyse baseline information for physical, biological and socio-economic environments in the project area;
- Discuss the legal and regulatory issues associated with the proposed project;
- Predict and assess the potential impacts of the project;
- Propose appropriate mitigation measures for any negative impacts and enhance measures for the positive impacts resulting from implementing the project;
- Allow for public participation in order to incorporate views of neighbours, members of public and stakeholders during project implementation;
- Prepare an Environmental Management Plan (EMP);
- Prepare an EIA Report for submission to NEMA

1.3 Terms of Reference (TOR)

- I The proposed location of the project;
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project;
- The objectives of the project;
- The technology, procedures and processes to be used, in the implementation of the project;
- The materials to be used in the construction and implementation of the project;
- The products, by-products and waste generated by the project;
- A description of the potentially affected environment;
- The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated;
- Alternative technologies and processes available and reasons for preferring the chosen technology and processes;
- Analysis of alternatives including project site, design and technologies and reasons for preferring the proposed site, design and technologies;
- An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the cost, time frame and responsibility to implement the measures;

- Provision of an action plan for the prevention and management of foreseeable accidents and hazardous activities in the case of carrying out activities or major industrial and other development projects;
- The measures to prevent health hazards and to ensure security in the working environment for employees and for the management of emergencies;
- An identification of gaps in knowledge and uncertainties which were encouraged in compiling the information;
- An economic and social analysis of the project;
- An indication of whether the environment of any other state is likely to be affected and the available alternatives and mitigating measures; and,
- Such other matters as the Authority may require including public consultation with various stakeholders.

1.4 Methodology of EIA

The environmental impact assessment study was based on desk studies, field assessments, discussions with the proponent, and views from neighbours. The exercise was carried out through the following key steps:

(i) Screening

This is the first step on evaluation of requirements of EIA study on the proposed project. The project is listed under the Second Schedule of EMCA 1999, as projects that should undergo Environmental Impact Assessment and EMCA requires for an EIA Report to be done. This project was found to require an EIA full study.

In addition the regulations require that project screening be undertaken to establish the environmental relevance of a project. The environmental relevance of a project depends on the type, location, sensitivity, and scale of the project, as well as the nature and magnitude of its potential impacts.

(ii) Scoping

The scoping exercise was undertaken to focus on the potentially significant impacts. During scoping, discussions were primarily held with the project proponent; project consultants and stakeholders, and involved clarification of the proposed project and environmental aspects that need to be considered during project implementation.

(iii) Assessment

A checklist was used as a starting point for collecting baseline information and carrying out the assessment.

Results of the evaluation were then used in identifying environmental effects which are likely to be key issues in relation to the environmental impacts and sustainability of the project. The next step involved identification of changes that are most significant and the assessment of the overall impact.

Field data collection was carried out through use of observations, photography, site visits and consultation with neighbours/stakeholders. Visual inspections were carried out in the proposed project area to get an impression of the physical features, land use, vegetation cover, existing infrastructure and land development.

The scope of the study complied with legislative requirements set out in the EMCA 1999 and also conformed to the provisions of the Environmental (Impact Assessment and Audit) Regulations 2003.

1.5 Duties of the Proponent

It will be the duty of the proponent to ensure that all financial and legal requirements as pertaining to the development are met as specified by the applicable laws. The Proponent MS DAIMA GAS LIMITED has provided the following documents in line with complying with the applicable EIA requirement

- Proponents Registration Certificate *(Appendix1)*
- Land Lease agreements *(Appendix 2)*
- Design Layout of the Storage and bottling facility *(Appendix 4)*
- KRA PIN *(see Appendix 5)*

It is also the duty of the proponent to assess competence of the contractor by ensuring:

- They are competent in the type of Gas process work to be carried out
- They are trained in safety requirements
- They have in place a suitable organizational Health and safety Policy arrangements in place
- High quality extent of Risk Assessment
- They have a good track record in health and safety performance (number of accidents etc)
- Has any enforcement action been taken against them?
- Do they produce up to date method statements?
- Do they monitor Health and safety and carry out site inspections?
- What Qualifications and Skills do they bring to the project?
- Do their workers carry a suitable skills card?
- Are they members of a professional body or trade association?
- Do they have employer's liability and public liability insurance?
- Do they have any references from previous clients?
- How do they appraise and select sub-contractors?
- What are their client liaison arrangements?

1.6 Duties of the Contractor

- Prepare and maintain an approved time and progress chart, showing clearly the period allowed for each section of the work.

- The contractor is to comply with all regulations and by-laws from various government authorities including serving of notices and paying of the fees.

- During the night, public holidays and any other time when no work is being carried out onsite, the contractor shall accommodate only security personnel, site office caretakers and never should a labour camp be allowed onsite.

- The contractor shall make good at his own expense any damage he may cause to public and private roads and pavements in the course of carrying out his work.
- The architect shall define the area within the site, which may be occupied by the contractor for use as storage on the site.
- The contractor shall provide at his own risk and cost all water required for use in connection with his works including work of subcontractors, and shall provide temporary storage tanks.
- The contractor shall make his own arrangement for sanitary conveniences for his workmen. Any arrangements so made shall be in conformity with the public health requirements for such facilities and the contractor shall be solely liable for any infringement of the requirements.
- The contractor shall be responsible for all the action of the subcontractor.
- The contractor shall take all possible precaution to prevent nuisance, inconvenience or injury to the neighbouring properties and to the public generally, and shall use proper precaution to ensure that safety of wheeled traffic and pedestrian is maintained.
- All work operations, which may produce elevated levels of noise, dust, vibration, or any other discomfort to the member of public, workers and/or persons in vicinity of the project site must be undertaken with care, with all necessary safety precautions taken.
- The contractor shall take all effort to muffle the noise from his machineries, equipment and workmen to not more than 85 Decibels.
- The contractor shall upon completion of the works, remove and clear away all plant, rubbish and unused materials and shall leave the whole of the site in a clean and tidy state to the satisfaction of the project architect. He shall also continuously remove from the site all rubbish produced in order to maintain the tidiness of the premises and its immediate environs.
- The standard of workmanship shall not be inferior to the Building Codes and /or the Kenya Bureau of Standards where applicable. No materials for use in the permanent incorporation into the works shall be used for any temporary works or purpose other than that for which it is provided. Similarly, no material for temporary support may be used for permanent incorporation into the works.

- All the materials and workmanship used in the execution of the project shall be of the best quality and description. Any material condemned by the architect shall immediately be removed from the site at the contractors cost.

1.7 Project Cost

The project is estimated to cost **KSHs. 11,500,000.**

1.8 Proposed Project Site Image

Figure 1.1- satellite photo of the proposed site

2.0 POLICY, LEGAL AND REGULATORY FRAMEWORK

2.1 Policy Framework

The Kenya Government's environmental policy aims at integrating environmental aspects into national development plans. The broad objectives of the national environmental policy include:

- Optimal use of natural land and water resources in improving the quality of human environment;
- Sustainable use of natural resources to meet the needs of the present generations, while preserving their ability to meet the needs of future generations;
- Integration of environmental conservation and economic activities into the process of sustainable development;
- Meeting national goals and international obligations by conserving bio-diversity, arresting desertification, mitigating disasters, protecting the ozone layer and maintaining an ecological balance on earth.

2.1.1 National Environmental Action Plan (NEAP)

According to the Kenya National Environmental Action Plan (NEAP, 1994) the government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programs that disregard environmental sustainability. Following on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. Under the NEAP process Environmental Impact Assessments were introduced targeting the industrialists, business community and local authorities.

2.1.2 Policy on Environment and development

The policy on Environment and Development presents broad categories of development issues that require sustainable approach. These issues include among others land and land based resources (e.g. agricultural and land use practices) and water resources (e.g. environmental challenges) as well as the human settlement sub-sectors. Among the specific goals of the policy are:

(i) To incorporate environmental management and economic development as integral aspects of the process of sustainable development,

To encourage sustainable utilization of resources and ecosystems for the benefit of the present generations, while ensuring their potential to meet the needs of the biosphere and future dependents.

2.1.3 National land use guidelines

Guidelines on Energy Management

Background

The provision of energy services is essential for industrialization, social development and improved quality of life. In addition, affordable energy is essential for eradicating poverty, improving human welfare, and raising living standards. The environment provides natural resources used as raw materials for the energy supply. Activities related to energy production, distribution and consumption are perhaps the largest single category of benign sources of adverse anthropogenic impacts on the environment.

2.2 Legal Framework

2.2.1 Environment Management and Coordination Act (EMCA), 1999

The EMCA, 1999 provides the legal framework for management of the Environment and other related issues in Kenya. It is the Policy of the Government of Kenya that EIA be conducted for planned projects that are likely to cause, or will have, significant impacts on the Environment, so that the adverse impacts can be foreseen, eliminated or mitigated. It is also policy of the Government that the EIA process be interdisciplinary, fully transparent so that the stakeholders have access and can express their views. This

is in order that the process serves to provide a balance between environmental, economic, social and cultural values for purposes of sustainable development of the entire country. The policy therefore, through the use and application of EIA, seeks to integrate environmental concerns in all development policies, plans, projects and programs of National, Regional, County and Local levels with full public participation of all stake holders. Other laws include:-

- The Physical Planning Act
- Energy Act (Energy Management) Regulations, 2006
- The Local Authority Act
- The Public Health Act
- The Environmental Management and Coordination Act of 1999
- The Environmental Management and Coordination (Water Quality) Regulations, 2006
- The Environmental Management and Coordination (Waste Management) Regulations, 2006
- The Employment Act 2007
- The Labor Institutions Act 2007
- The Work Injuries Benefits Act 2007
- The Occupational Safety and Health Act 2007
- The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009.

2.2.2 The Physical Planning Act

Section 29 of the Act empowers the local Authorities to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same section allows for prohibition or control of the use and development of an area.
Section 30 states that any person who carries out development without development permission will be required to restore the land to its original condition. It also states that no other licensing authority shall grant license for commercial or industrial use or occupation of any building without a development permission granted by the respective local Authority.

2.2.3 The Local Authorities Act

Under the Local Authorities act, the County Council of Kisii assumes a number of roles in its area of jurisdiction, which includes the development area. The roles include issuance of licenses for businesses, collection of refuses, setting up of adequate lighting, provision of water and sewerage services in the area, among others. Therefore for effective management; some of the requirements of the proposed project such as adequate and efficient sewage services from the council, for implementation of the proposed project would have to be carried out in consultation with the council.

2.2.4 The Public Health Act

Part IX section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health.

Section 116 requires that local Authorities take all lawful necessary and reasonable practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to injuries or dangerous to human health.

2.2.5 The Environmental Management and Coordination (Water Quality) Regulations, 2006

These are described in Legal Notice No. 120 of the Kenya Gazette Supplement No. 68 of September 2006.
These Regulations apply to drinking water, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife and water used for any other purposes. This includes the following:

- Protection of sources of water for domestic use;
- Water for industrial use and effluent discharge;
- Water for agricultural use;

2.2.6 The Environmental Management and Coordination (Waste Management) Regulations, 2006

These are described in Legal Notice No. 121 of the Kenya Gazette Supplement No. 69 of September 2006.
These Regulations apply to all categories of waste as provided in the Regulations. These include:

- Industrial wastes;
- Hazardous and toxic wastes;
- Pesticides and toxic substances;
- Biomedical wastes;
- Radioactive substances;

These Regulations also outline requirements for handling, storing, transporting, and treatment/disposal of all waste categories as provided therein.
Relevant parts of this regulation include

- Prohibition of any waste disposal on a public highway, street, road, recreation area or in any public place except in designated waste receptacle;
- All waste generator to collect, segregate and dispose such waste in a manner provided for under these regulations;
- All waste generators to minimize waste generated by adopting cleaner production methods;
- All waste transporters to be licensed according to the act;
- All vehicles used to transport waste to be labeled in such a manner as may be directed by the Authority;
- Collection and transportation of the waste to be done in such a manner no to cause scattering of the waste;
- The vehicle and equipment for waste transportation to be in such a manner not to cause scattering of or flowing out of waste; and

- The vehicles for transportation and other means of conveyance of waste to follow the scheduled routes approved by the authority from the point of collection to the disposal site.

2.2.7 Employment Act 2007

(i) General Principal

The Act constitutes minimum terms and conditions of employment of an employee and any agreement to relinquish vary or amend the terms set shall be null and void.

The act stipulates that no person shall use or assist any other person, in using forced labour. Clause 5 of the act states that its shall be the duty of the Minister, Labour officer, the National Labour Court and the subordinate labour courts to; Promote equality of opportunity in employment in order to eliminate discrimination in employment Promote and guarantee equality of opportunity for a person who, is a migrant worker or a member of the family of the migrant worker lawfully within Kenya

No employer shall discriminate directly or indirectly, against an employee or prospective employee or harass an employee or prospective employee on the following grounds; race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability, pregnancy, mental status or HIV status. An employer shall pay his employees equal remuneration for work of equal value.

(ii) Part IV Rights and duties of employment

The provisions of this part and part VI constitute basic minimum and conditions of contract of service. The employer shall regulate the hours of work of each employee in accordance with provisions of this Act and any other written law. Subsection (2) of section 27 states that an employee shall be entitles to at least one rest day in every period of seven days. An employee shall be entitles to not less that twenty-one working days of leave after every consecutive months.

(iii) Maternity Leave

Section twenty of the Act stipulates that a female employee shall be entitled to three months maternity leave with full pay. Subsection 8 of section 29 further states that no female employee shall forfeit her annual leave entitlement on account of having taken her maternity leave.

(iv) Section 37 (conversion of casual employment to term contract)

Where a casual employee works for a period or a number of continuous working days which amount in the aggregate to the equivalent of not less than one month; or performs work which cannot reasonably be expected to be completed within a period, or a number of working days amounting in the aggregate to the equivalent of three months or more. The contract of service of the casual employee shall be deemed to be one where wages are paid monthly. In calculating wages and the continuous working days, a casual employee shall be deemed to be entitled to one paid rest day after a continuous six days working period and such rest day or public holiday which falls during the period under consideration shall be counted as part of continuous working days.

2.2.8 Work Injuries Benefits Act 2007

(i) Obligations of Employers
Section 7 of the Act stipulates that every employer shall obtain and maintain an insurance policy, with an insurer approved by the Minister in respect of any liability that the employer may incur under this Act to any of his employees.

(ii)Registration of employer
Every employer carrying on business in Kenya shall within the prescribed period and in the prescribed manner register with the Director of Occupational Health and Safety Services and any other information as the Director may require. subsection 4 of section 8 of the Act states that where an employer carries on business in more than one workplace, or carries on more than one class of business, the Director may require the employer to register separately in respect of each place or class of business.

(iii) Employer to keep record (Section 9)
Section 9 states that an employer shall;
Keep a register or other record of the earnings and other prescribed particulars of all employees and produce the same on demand by the director for inspection. Such records shall be retained for at least six years after the date of last entry.

(iv) Right to compensation
An employee who is involved in an accident resulting in the employee's disablement or death is subject to the provisions of this Act, and entitled to the benefits provided for under the Act. Subsection 3 of section 10 of the Cat however states that no employee shall be entitled to compensation if an accident, not resulting in serious disablement or death, is caused by the deliberate and wilful misconduct of the employee. Section 12 of the act stipulates if an employee is injured in an occupational accident or contracts an occupational disease while the employee, with the consent of the employer. is engaged in any organized first aid, ambulance or rescue work, or fire fighting or other emergency services, the accident or disease is for the purpose of this Act, deemed to have arisen out of an in the course of the employee's employment.

(v) Reporting of accidents
A written or verbal notice of any accident shall be given by or on behalf of the employee concerned to the employer and a copy to the Director of occupational health nod Safety within twenty-four hours of its occurrence in case of fatal accident.

(vi) Lapse of right to benefits
A right to benefits in accordance with this Act shall lapse if the accident is not reported to the employer within months after the date of such accident. However, it shall not be bar to compensation if it is proved that the employer had knowledge of the accident from any other source. Section 30 of the Act states that compensation for permanent disablement shall be calculated on the basis of earnings subject to the minimum and maximum amounts determined by the minister after consultation with the board. In case of a fatal accident compensation shall be paid to the dependants of the employee in

accordance with the set provisions in the third schedule. The employer shall further be liable to pay reasonable expenses for the funeral of the deceased employee subject to the maximum amount determined by the minister, after consultation with the National council for occupational Health and Safety The First Schedule of the Act gives the minimum degree of Disablement for various body parts while the second Schedule gives a list of work description and the associated occupational disease.

2.2.9 Labor Institutions Act 2007

Section 34 of the act stipulates that an authorized officer may either alone or in the presence of another person, enter any premises or place where persons are, or may be employed for the purpose of performing his duties as specified under the Act.
The labour officer may, for the purpose of monitoring or enforcing compliance with any law require the production of wages sheets or other employment records kept by an employer, enter inspect and examine all latrines and other sanitary arrangements or water supply, inspect and examine all food provided or appearing to be provided for employees, and take samples thereof in duplicate, in the presence of the employer or the employers representative which samples shall be sealed and one sample so sealed shall be left with the employer, order that all buildings and premises where employees are housed or employed be kept in a clean and sanitary condition.
Section 37 of the act states that the medical officer shall exercise the powers conferred upon the labour officer and in addition;

- Order an employee who, in his opinion is sick and for whom the conditions prevailing at the place of employment are not conducive to rapid recovery of his health to proceed to hospital and in that case the employer shall at the earliest opportunity and at his own expense send the employee to the place of work or to a hospital, as the case may be.
- Condemn any food provided for employees which, in the opinion of the medical officer, is unfit for human consumption, and all food so condemned shall be destroyed forthwith in the presence of the medical officer.
- Order at the expense of the employer, such variety of food for an employee as he may deem necessary
- Inspect all drugs and medicine provided for the use of employees

2.2.10 Occupational Safety and Health Act 2007

(i) Part II – General Duties of the Occupiers

In Section 6 (1), it is stated that the occupier shall ensure the safety, health and welfare at work of all persons working in his work place.
Without prejudice to the generality of an occupier's duty under sub section 1 above, the duties of the occupier includes:-

- The provision and maintenance of plant and systems and procedures of work that are safe and without risk to health;
- Arrangements for ensuring safety and absence of risks to health and connection with the use, handling, storage and transport of articles and substances;
- The provision of such information, instruction, training and supervision as is necessary to ensure the safety and health at work of every person employed;

- The maintenance of any workplace under the occupier's control, in a condition that is safe and without risks to health and the provision and maintenance of means of access to and egress from it that are safe and without such risks to health;
- The provision and maintenance of a working environment for every person employed that is, safe, without risks to health, and adequate as regards facilities and arrangements for the employees welfare at work;
- Inform all persons employed of:-
- Any risks from new technologies; and
- Imminent danger; and
- Ensuring that every person employed participates in the application and review of safety and health measures.

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2.2.11 The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009;

Section 14 (1) says, where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose requirements on how the work is to be carried out including but not limited to requirements regarding :
(a) Machinery that may be used, and
(b) The permitted levels of noise as stipulated in the Second and Third Schedules to these Regulations.
(c) Any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do not exceed 0.5 centimetres per second beyond any source property boundary or 30 meters from any moving source.
On Permissible noise levels, section 5 say No person shall make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.
Part II of the general prohibition of this regulation state that except as otherwise provided for in this regulations, no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Part (2) of the general prohibitions stated that in determining whether noise is loud, unreasonable, unnecessary or unusual the following factors may be considered:-

- Time of the day;
- Proximity to residential area;
- Whether the noise is recurrent, intermitted or constant;
- The level and intensity of the noise;
- Whether the noise has been enhanced in level or range by any type of electronic or mechanical means; and
- Whether the noise can be controlled without much effort or expense to the person making the noise.

Part 2 of section III states that any person wishing to operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan, air-conditioning

apparatus or similar mechanical device or engage in any residential storey building or industrial activity which is likely to emit noise or excessive vibrations shall carry out the activity or activities within relevant levels prescribed in the first schedule to these regulations. Part III section 13 (1) states that except for the purpose specified in sub-Regulation (2)… no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the second schedule of the regulations.

2.2.12The Water Act 2002

The purpose of the Water Act is to provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services. Except for waters that are wholly situated in a private landowner's domain, the Act vests the rights over all surface and ground water in the state. This is only subject to the rights which users may acquire under license from time to time.
Part II, section 18 of the act provides for national monitoring and information systems on water resources.
Following on this, sub-section 3 allows the Water Resource Management Authority to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specified information, documents, samples or materials on water resources may be kept by a water user and the information thereof furnished to the authority.
Section 94 of the act makes it an offence to throw or convey or cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive or unwholesome matter or thing into or near to water resources in such a manner as to cause, or be likely to cause, pollution of the water resource.

2.2.13 Building Code 2000

Section 194 requires that where sewer exists, the occupants of the nearby premises shall apply to the local Authority for permit to connect to the sewer line and all the wastewater must be discharged in to sewers. The code also prohibits construction of structures or building on sewer lines.

2.2.14 Traffic Act (Cap 403)

This is an Act of Parliament that consolidates the law relating to traffic on the roads. The act it prohibits obstruction of traffic, either by persons or facilities which are constructed in such a way as to interfere with the flow of traffic on roads or road reserves.

2.2.15 Environmental (Impact Assessment and Audit) Regulations, 2003

The regulations apply to all policies, plans, programs, projects and activities specified in Part IV, Part V and the Second Schedule of the Act.
The regulation state as follows:
No proponent shall implement a project –
(*a*) Likely to have a negative environmental impact; or

(*b*) For which an environmental impact assessment is required under the Act or these Regulations; unless an environmental impact assessment has been concluded and approved in accordance with these Regulations.
(2) No licensing authority under any law in force in Kenya shall issue a license for any project for which an environmental impact assessment is required under the Act unless the applicant produces to the licensing authority a license of environmental impact assessment issued by the Authority under these Regulations.
(3) No licensing authority under any law in force in Kenya shall issue a trading, commercial or development permit or license for any micro project activity likely to have cumulative significant negative environmental impact before it ensures that a strategic environmental plan encompassing mitigation measures and approved by the Authority is in place.

2.2.16 Conservation of Biological Diversity (BD) Regulations 2006

These regulations are described in Legal Notice No. 160 of the Kenya Gazette Supplement No. 84 of December 2006. These Regulations apply to conservation of biodiversity which includes Conservation of threatened species, Inventory and monitoring of BD and protection of environmentally significant areas, access to genetic resources, benefit sharing and offences and penalties.

2.2.17 Fossil Fuel Emission Control Regulations 2006

These regulations are described in Legal Notice No. 131 of the Kenya Gazette Supplement no. 74, October 2006.
The regulations include internal combustion engine emission standards, emission inspections, the power of emission inspectors, fuel catalysts, licensing to treat fuel, cost of clearing pollution and partnerships to control fossil fuel emissions. The fossil fuels considered are petrol, diesel, fuel oils and kerosene.

2.3 Institutional Framework

2.3.1 Institutions under EMCA 1999

The Government established the following institutions to implement the EMCA 1999.

- National Environmental Council
- National Environmental Management Authority
- County Environmental Committees
- Public Complaints Committee
- Standards and Enforcement Committee

2.3.2 Water Resources Management Authority

The Water Resources Management Authority (WRMA) is of particular relevance to the project. Its mandate covers some sectorial issues which are applicable to environmental management, such as use of water resources, human settlement and administration of activities in the scheme.
Part III of the Water Act 2002 defines the powers and functions of WRMA which include:

- Developing principles, guidelines and procedures for the allocation of water resources;

- Monitoring the national water resources management strategy;
- Receiving and determining applications for permits for water use;
- Monitoring and enforcing conditions attached to permits for water use;
- Regulating and protecting water resources quality from adverse impacts;
- Managing and protecting water catchments;

2.3.3 International Conventions and Treaties

Kenya has ratified or acceded to numerous international treaties and conventions. Those that have implications on the project are described below:

Convention on Biological Diversity (CBD) 1993: The CBD adopts a broad approach to conservation. It requires Parties to the Convention to adopt national strategies, plans and programs for the conservation of biological diversity and to integrate the conservation and sustainable use of biological diversity into relevant sectorial and cross-sectorial plans, programs and policies. The proposed project is expected to conserve biodiversity, especially the rare and endangered species in the project area and its environs in compliance with the Environmental Management and Co-ordination (Conservation of Biological Diversity) Regulations, 2006.

United Nations Framework Convention on Climate Change 1992: Sets an ultimate objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system. Development projects in Kenya such as the proposed project are expected to take climate change considerations into account, to the extent possible, in their relevant social, economic and environmental policies and actions.

United Nations Convention to Combat Desertification 1994: Addresses the problem of the degradation of land by desertification and the impact of drought, particularly in arid, semi-arid and dry semi-humid areas. This convention is domesticated in EMCA 1999 via Section 46 where District Environment Committees are required to identify areas that require re-forestation or afforestation as well as to mobilize the locals to carry out these activities.

2.4 LPG Kenya Standards

Table 2.1: Standards to be used for the Proposed LPG facility

Mechanical Works	
KS 1938-1:2012	Kenya standards for handling, storage and distribution of liquefied petroleum gas in Domestic, commercial and industrial installations-code of practice. Part 1: Liquefied petroleum gas installations involving gas storage Containers of individual capacity not exceeding 150 L and a combined water capacity not exceeding 3000L per installation second edition.
KS 1938-2:2012	Part 2: Transportation of LPG in bulk by road, rail and sea. code of practice second edition.
KS 1938-3:2012	Part 3: LPG handling, storage and distribution in domestic, commercial
KS ISO 16486-3:2012	Plastic piping systems, unplastic polyanide for supply of gaseous,with fusion joining and mechanical joints:fittings
KS ISO 16486-5:2012	Plastic piping systems, unplastic polyanide for supply of gaseous,with fusion joining and mechanical joints:fitness for the purpose of system
KS ISO 16486-6:2012	Plastic piping systems, unplastic polyanide for supply of gaseous,with fusion joining and mechanical joints:handling and installation.

3.0 ENVIRONMENTAL BASELINE INFORMATION

3.1 Location, population and Geo-Political Data

Kisii County shares borders with Nyamira County to the North East, Narok County to the South and Homabay and Migori Counties to the West. The County lies between latitude 0^0 30' and 10^0 South and longitude 34^0 38' and 35^0 East and covers an area of 1,317.5 km². The County has an estimated population of 1,379,532 in 2018 comprising of 659,025 males and 720,507 females. It is divided into nine (9) Sub-Counties and 45 electoral wards. The Sub-counties include; South Mugirango, Bonchari, Nyaribari Chache, Kitutu Chache North, Kitutu Chache South, Nyaribari Masaba, Bomachoge Chache, Bomachoge Borabu and Bobasi.

3.2 Topography and geology

The county is mostly hilly and has several ridges in the east. It can be divided into three main topographical zones. The first zone covers areas lying below 1,500m above the sea level. The areas lying in this zone are located on the Western boundary and include parts of Suneka, Marani, and Nyamarambe. The Second zone covers areas lying between 1,500-1800 m above sea level. The zone occupies western parts of Keumbu and Sameta, Eastern Marani and Kuja River Basin.The Third zone covers areas lying above 1,800m above sea level. It covers parts of Eastern and Southern Keumbu, Masaba and Southern parts of Marani. The most notable features of these three topographical zones are hills of sameta (1,970m), Nyamasibi (2,170m), Kiongayo (1,710m), Kiamwasi (1,785m), Kiongongi, Kiombeta, Nsaria, Nyakeiri, Nyanchwa, Kegochi and Tunwa hills. The general slope of the land is from east to west.

The county lies on a geological base comprising Bukoban, Granitic, Nyanzian and Kavirondian rocks. The Bukoban type is the youngest and the most dominant. During the pre-cambrian era, some volcanic activity ejected lava which has formed the Nyanzian system rocks. The Kavirondian system consists of alternating bands of grit, Sandstone and mud stones. The rocks underlying this county are of little economic value. However, the Kisii soap stone found to the south of the district at tabaka provides a reasonable resource for the carving industry, electrical insulators and chalk. The hilly nature of the county exposes it to serious soil erosion and makes road communication difficult especially during the rainy season when road become impassable or the tarmac gets eroded.

3.3 Soils

Seventy five per cent of the county has red volcanic soils (nitosols). These soils are deep and rich in organic matter. The rest of the county has clay soils which are poorly drained (Phaazems), red soils, and sandy soils. There are also black cotton soils (verisols) and organic peat soils (phanosols) in valley bottoms. The phanosols support brick making, pottery and tile manufacturing in the valley bottoms. The red volcanic soils support the growth of cash crops such as Tea, Coffee, Pyrethrum and subsistence crops like maize, beans and potatoes.

The county can be divided into three ecological zones comprising the upper midland (UM) 75% Lower highland (LH) 20% and lower Midland 5%. About 78% of the county is arable.

3.4 Water Resources

The county has several permanent, rivers and streams which drain into Lake Victoria. Kuja is the main river and it starts from Kiabonyoru in Nyamira County. Sources of water in the county are varied. The key sources are 56% springs, 30% stream and rivers, 7% piped water, and 4% bore holes and wells while 3% relies on other sources including rainwater. The majority of the people (Local) hardly walk more than 2km in search of wafer owing to the reinforced by roof catchment and bore holes except along the kisii border.

The existing piped water supply capacity is 3,400m^3 per day, while the reported current water demand in Kisii town is about 11,000m^3 per day. The entire service area requires 18,000 m^3 per day including institutional and industrial requirements. The distribution network serves just over 3,100 consumer connections though only 620 are active. The existing piped water supply capacity is 3,400m^3 per day, while the reported current water demand in Kisii town is 11,000m^3 per day. The entire service area requires 18,000m^3 per day both of which also include institutional and industrial requirements.

3.5 Drainage

The area has a rolling terrain that flattens towards Lake Victoria. Most of the town drains north-westwards towards Lake Victoria through River Riana next to Daraja Mbili. Kisii has abundant rainfall, averaging over 1,600mm annually. The rainfall recharges dozens of springs in the area.

The town is drained by numerous streams that constitute tributaries of River Riana. The streams rise from the eastern highlands and flow to the western side. The streams are permanent as the region has high and reliable rainfall. The streams have cut deep and narrow water course valleys that dissect numerous parts of the town. These deep and steep valleys pose major problems in the development of the town especially roads and trunk infrastructure.

3.6 Forest & Vegetation

There are no gazzetted forests in Kisii County. Farmers for a long period of time have been planting blue gum for timber and fuel and fencing purposes. This species is preferred because the area receives sufficient rainfall, which facilitates its maturity within a short period but lately the same species is threatening the county with an acute shortage of water as it takes up to 1000 litres of water in three days hence posing a great danger to wetlands and water catchment areas. Majority of the people in the county depend on wood fuel for their energy needs, in general there is the scarcity of wood in the county.

Much of the natural indigenous vegetation cover in Kisii has been depleted and instead replanted with exotic tree species like the blue gums and black wattle. The blue gum is the main sources of timber in the county and the wattle supply fire wood and charcoal. The county however imports substantive volumes of timber and charcoal products in order to meet its demand.

3.7 Wildlife and Tourism

Since the county is densely populated with people practicing intensive agriculture, it is

not favourable for wildlife therefore there is no registered game park in the county. Some of the wild animals that do exist like snakes and various species of birds live in the bushy river valleys. The county's landscape however offers scenic beauty.

3.8 Commercial Minerals

The only minerals of commercial importance available in the county are granite and soaps tone which are being mined by cooperatives and groups. The carvings made are sold locally and some are exported to foreign countries. This is also the area where the project lies.

3.9 Population

Based on the 2009 Kenya Population and housing census (KPHC) the county population was 1,152,282 comprising 550,464 males and 601,818 females respectively. The population was projected to be 1,226,873 in 2012 consisting of 586,062 males and 640,808 females with a growth rate of 2.1%, the population is estimated to be 1,306,652 in 2015 with 624,171 males and 682,481 females and is projected to be 1,362,779 with 650,932 females and 711,797 females by 2017.

3.10 Transport

Public transportation, which is operated privately, is available throughout the town. A good example is private-owned car-pooling taxis (matatus), taxi cabs and boda-boda (motorcycle taxis) as an alternative to privately owned vehicles

Kisii is strategically positioned and it is easy to get to Tabaka Soapstone quarries, the Maasai Mara Game Reserve in Narok County, Lambwe Valley Game Reserve in Homa Bay County, Kisumu, Lake Victoria, and the Kenya/Tanzania or Kenya/Uganda border points.

3.11 Economy

Kisii town has a vibrant business sector mainly derived from commerce and agriculture. Farming is the main economic activity undertaken in Kisii County. High and well distributed rainfall, supported by good soils enable farming of both cash and food crops like tea, pyrethrum, maize, coffee and other crops. Small scale farming is the most important primary production activity in the district. There are about 112,000 small holdings in the county ranging from 0.5 acres to 4 acres of land. The average land holding in the county is 1.5 acres. The county is endowed with rich agricultural soils which support a variety of crops. Most of the farmers practice both subsistence and cash crop production, and this type of production pattern exists in all the divisions.

The ever-bustling Kisii town is the fastest growing town in western Kenya thanks mainly to its dense population, political stability and general tranquillity; making it a commercial hub serving some of the neighbouring counties. This fact is strongly supported by the entrance of many financial institutions and big chain supermarkets within the town. The emergence of many tertiary education institutions has also largely contributed to increased business leading to new businesses being installed daily such as the hospitality sector with hotels, bars, restaurants, sports pubs, among other commercial activities.

Some of the financial institutions include: - Kenya Commercial Bank, Barclays Bank, National Bank, Post Bank, Co-operative Bank, Equity Bank, I&M Bank, Credit Bank, Kenya Women Finance Trust, Diamond Trust Bank, Eco-Bank, Family Bank, Chase

Bank, Bank of Africa, K-Rep Bank etc The major supermarkets in Kisii include Nakumatt, Tuskys, Uchumi, Naivas, Kisiimattress and many smaller brands. Kisii has few industrial activities and the major manufacturing concern is the Coca-Cola Bottling plant. Soapstone quarrying and carving is another major industry albeit in a small area of Tabaka southwest of the town and a few kilometres off Kisii-Isibania road.

3.12 Health

Kisii Teaching and Referral Hospital is the largest government-owned health facility in the county. The town has reputable private hospitals and medical centers. These include Hema Hospital, Getembe Hospital, Christa Marianne Hospital, Nyangena Hospital, Bosongo Medical Center, Ram Hospital and the Agha khan hospital being one of the new ones opened serving the municipality and the county in general.

3.13 Housing conditions

Due to its high population density as a result of rural urban migration, many tertiary education institutions and the devolved system where many professionals have moved from the capital cities back to the counties; there is growing demand for housing especially within Kisii town which is the administrative capital of Kisii County. This coupled with an acute shortage of land as a result of many residents' preference for owner-occupancy homes over purchasing flats or homes built by the government or the municipality has led to most of its suburbs being developed without proper planning. Many residents owning private homes and flats can be found all over the municipality and its precinct areas such as organized suburbs or municipality wards such as Milimani, Gesonso, Itierio, Nyangena, Nyamataro, Mwembe Tayari, Gekomu, Menyinkwa, Nyabururu, Embassy and Nyanchwa.

3.14 Climate

It exhibits a highland equatorial climate resulting into a bimodal rainfall pattern with average annual rainfall of 1,500mm. The long rains are between March and June while the short rains are received from September to November; with the months of January and July being relatively dry. The maximum temperatures in the County range between 21ºC-30ºC, while the minimum temperatures range between 15ºC and 20ºC. The high and reliable rainfall coupled with moderate temperatures are suitable for growing crops like tea, coffee, pyrethrum, maize, beans and bananas as well as dairy farming.
However, the high rains and hilly terrain make roads inaccessible resulting to high losses in the agricultural sector.

3.16 Waste Management

The solid waste generated daily in the town by various firms, organizations and individuals is managed by the County government and a few private contractors. In the absence of trunk infrastructure like sewage system, most developments are on conservancy/septic tanks and residents contract private solid waste disposal companies.

3.17 Site Physical Location

The project site is situated along the Kisii-Rongo road at the Celebration Center petrol station about 1.5 km from the Suneka shopping Center. The site is predominantly agricultural and commercial though there are scattered residential homes. The site GPS

coordinates are Latitude:-0.6933991005644202, Longitude: 34.69036496244371**.** ***(See Site Google Map in appendix 6 & photo logs in appendix 7)***.

4.0PROJECT DESCRIPTION

The project will entail the construction and installation of two 25MT gas vessels in two phases

4.1 Project Design Consideration

Currently the site still has no installed facilities
The site will be developed to include the following facilities (refer to layout of LPG Plant):

- Secure stone boundary wall of at least 3m high
- Construction of a brick blast wall in the inner face of the boundary wall
- Acquisition and installation of twoAboveground 25 Metric Ton Tanksand all associated Civil Works,
- Construction of a LPG cylinder filling and storage warehouse,
- Paving of all driveways within the facility,
- Construction of the Office and Ablution Blocks,
- Construction of a Genset house,
- Installation of Fire Fighting System for the entire plant,
- Construction of a fire water storage tank,
- Installation of borehole pump and other water pump systems,
- LPG Tank containment area;
- Appropriate Drainage channels and lines,
- Access Road;

4.2 Project Activities

The project activities include the following;

- Site preparation and construction activities that involve installation of two number aboveground 25MT LPG Storage Tanks and all associated Civil Works, Installation of Cylinder filling and storage warehouse, paving of all driveway within the plant, construction of administration office and ablution blocks, construction of a Genset house, Installation of Fire Fighting System for the entire plant, erection of a fire water storage tank and improvement of the access road from the Kisii – Rongo Highway.
- LPG operation activities that include transportation of LPG Gas and Storage at the New LPG Plant.
- Filling of LPG Cylinders and Distribution to Outlets for consumers.

4.3 Description of the Project's Construction Activities

During the construction of the proposed LPG Plant, skilled labor (contractor) shall be procured through competitive bidding to ensure that the Plant is constructed following the approved designs and installation of the various LPG storage and filling facilities. The construction shall endeavor to maintain the site environmental integrity.

The proponent undertakes to ensure that priority is given to local populations to provide unskilled labor during the construction activities. The construction team shall also source for any required raw materials locally where such materials are established to be locally available. This will ensure that the project generates employment for the local

community who are entitled to enjoy any benefits accruing from the development of the project within their locality.

The construction of the LPG Plant will involve the following activities:

- Excavation of soils and geological formations. The excavated soil will be gathered together, temporarily stored within the site and disposed of appropriately.
- Construction activities of the proposed LPG Plant structures and other activities associated with civil works.
- Installation of the LPG Tanks, Gas Pipe Work and Gas Filling Equipment.
- Installation of Gas sensors.

The scope of works will be in main 3 parts:

- Civil Works
- Electrical Works
- Main Plant / Mechanical works**:**

4.3.1 Civil works

The civil works will be composed of the following:

- Plant driveway and boundary wall,
- Office and ablution block,
- Genset house,
- Borehole,
- Two Aboveground Bulk LPG Storage Tanks with a capacity of 25 Metric Tons each.
- Cylinder filling and storage warehouse/shed.

4.3.2 Electrical Works

The electrical works will be composed of the following:

- Electrical System consisting of main power supply, supply and installation of Generator set, all cables to equipment such as compressors, pumps & cylinder filling equipment, lighting and ESD systems.

4.3.3 Main Plant works and Mechanical Works

LPG Filling Equipments.

- Auto checks and Manual scales.
- Heat shrink machine.
- Decanting System.
- Top up system.
- Filling Pump and Offset Filling for Larger Cylinders
- LPG filling scales (both semiautomatic and manual)

4.3.4 Piping for LPG and Vapor

Includes piping flanges, fittings, gasket nuts and bolts

Scope includes

- Piping (LPG and Vapor)
- Fill line from truck with safety fitting
- Pump suction and Pump discharge lines
- Bypass return line
- Truck Offloading/Loading
- Fire Fighting complete with 150 Cubic Meter Water Tank, 75m^3/hr Diesel fire engine, 3" ring main & fire monitors.

4.4 OPERATION PHASE

4.4.1 Receipt of LPG bulk:

The bulk LPG transported from refinery locations to bottling plants will be unloaded using pressure differential method. Received LPG will be stored in two above ground vessels each having 25MT capacities (2X25MT). LPG compressors will be used for pressurizing the vessels which is to be unloaded by taking the LPG vapor from the receiving vessel and the liquid line will be connected to facilitate transfer of liquid LPG.

4.4.2 Storage of Bulk LPG

Bulk LPG is stored in pressurized vessels at moderate pressure of 6 – 8 kg/cm_2 g under equilibrium. LPG will be stored in pressure vessels in two phases. LPG in the form of liquid will be filled up to 85% max of the water capacity and the balance 15% vapor space is left for expansion.

4.4.3 Filling machine:

LPG filling shed for bottling in cylinders will have 7 linear filling points capable of filling about 100cylinder/Hr. Gas stop valves are provided such that in any case of leakage from filling hose/gun, it will stop automatically for further flow.

4.4.4 Bottling operations

Empty cylinders will be received either from new cylinder manufacturer/ repairer or from distributors i.e., from the market.

New/repaired cylinders are purged with LPG vapor for ensuring no air trapped in the cylinders, before filling LPG into the cylinder.

Pre-filling checks like visual check, cylinder due for testing and any physically damaged cylinders will be removed for rectification.

Fit cylinders will be fed in the 7 filling points by manually. The filling gun fixing, filling operation including cut off, ejection of cylinders will be done automatically. The cutoffs of filled cylinders will be based on gross weights.

Filled cylinders will be weighed and the tolerance will be -100 gms to +200 gms. The cylinders filled out of this range will be called over or under filled cylinders which will be pushed into a conveyor for correction. Correct weight cylinders will be then sent for leak checking.

Over filled and under filled cylinders will be corrected using ICU (Integrated Weight Correction Unit) provided on line and sent for re-checking and the correct weight cylinders will be sent down the line for further checks.

Valve leak/bung leak cylinders will be checked through electronic VL/BL leak detector. The permissible leak is 0.5 gms per hour.

The electronic ring detector checks 'O' ring inside the valve. Cylinders which are not leaky will be sent down the line.

Cylinders which are correctly filled and having no leaks will be sealed with PVC seals. Filled cylinders will be stored and dispatched to the distributors as per the requirement.

'O' ring damaged /missing cylinder detected will be changed with new 'O 'rings and sent for re-testing in O ring leak detector. Valve leakage cylinders will be evacuated completely and de-pressurized and old valve is replaced with new valve and the cylinder is taken back for filling. Other defective cylinders will be marked with identification and stacked separately. These cylinders will be rectified or de-shaped depending up on the nature of defect.

4.4.6. Utilities system

- Compressed air system
- Service water system
- High Speed Diesel (HSD) System
- Electric Power Distribution System

4.4.7 Safety & communication system

Fire fighting system

Gas Monitoring System

Public Address & Paging System

4.4.8 Fire Fighting Facilities:

The fire fighting detection and prevention system in the storage & handling area will comprise of the following:

150 Cubic Meter Water Tank, 75m^3/hr Diesel fire engine
Other fire pump house equipment like security air compressor for MVWS system, Fire Alarm Panel

Hydrants and monitors

Medium velocity water spray system
Pump House and above ground bullet.

Fire detection and alarm system Gas
detection system

Manual call points and Emergency shutdown system

4.8 Energy resources
The area is already connected to the Kenya Power mains. Necessary guidelines and precautionary measures relating to the use of electricity shall be adhered to. The proponent will also install solar panel roofing tiles to reduce on energy costs during the project implementation.

4.9 Masonry, concrete work and related activities
Construction of the buildings walls, foundations, floors, pavements, drainage systems among other facilities will involve a lot of masonry work and related activities. General masonry and related activities will include stone shaping, concrete mixing, plastering, and slab construction, construction of foundations, and erection and modification of building/equipment walls and curing of fresh concrete surfaces. These activities are known to be labour intensive and will supplement by machinery such as concrete mixers.

4.10 Structural steel and roofing works
The structures will be reinforced with structural steel for stability. Structural steel works will involve steel cutting, welding and erection. Roofing activities will include raising and fastening the roofing materials.

4.11 Plumbing
Installation of pipe-work for water distribution will be carried out within the plant. In addition, pipe-work will be done to connect sewage from the buildings to the sewer line system, and for drainage of storm water from the rooftop into the storm water drainage system. Plumbing activities will include metal and plastic cutting, the use of adhesives, metal grinding and wall drilling among others.

4.12 Electrical work
Electrical work during construction of the project will include installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets etc. In addition, there will be other activities involving the use of electricity such as welding and metal cutting.

4.13 General repairs and maintenance
The buildings and equipment will be maintained regularly during the operation and will include activities such as repair of buildings walls and floors, repairs and maintenance of electrical gadgets and equipment, repairs of leaking water pipes, painting, and maintenance of flower gardens and grass lawns among others during the operational phase of the project.

4.14 Construction Specifications
Design of LPG Vessels

4.14.1 Applicable Design Construction Codes
Vessels shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division I or 2.

When complete rules for any specific design are not given, the manufacturer, subject to the approval of the purchaser, shall provide a design as safe as would be provided in the currently applicable code listed above.

4.14.2 Design Pressure and Temperature

The design pressure of LPG vessels shall not be less than the vapor pressure of the stored product at the maximum product design temperature. The additional pressure resulting from the partial pressure of non-condensable gases in the vapor space and the hydrostatic head of the product at maximum fill shall be considered. Ordinarily, the latter considerations and the performance specifications of the relief valve require a differential between design pressure and maximum product vapor pressure that is adequate to allow blow down of the pressure relief valve.

Both a minimum design temperature and a maximum design temperature shall be specified. In determining a maximum design temperature, consideration shall be given to factors such as ambient temperature, solar input, and product run down temperature. In determining a minimum design temperature, consideration shall be given to the factors noted in the preceding sentence as well as the auto refrigeration temperature of the stored product when it flashes to atmospheric pressure.

DESIGN VACUUM LPG vessel design shall consider vacuum effects and be designed accordingly. Where an LPG vessel is not designed for full vacuum, some alternatives, in order of preference, are as follows:

a. Design for partial vacuum condition. This alternative is applicable when the vacuum conditions caused by ambient temperature conditions. The design pressure shall be equal to the minimum vapor pressure of the product at the minimum ambient temperature. In this situation, no additional protection against vacuum is needed.

b. Design for partial vacuum with a vacuum relief valve and a connection to a reliable supply of hydrocarbon gas. This alternative may compromise product quality.

c. Design for partial vacuum with a vacuum relief valve that admits air to the vessel. This alternative, under some conditions, may present a hazard from the presence of air in the LPG storage vessel, and this hazard shall be considered in the design.

4.14.4 Materials of Construction

All materials of construction shall meet the requirements of Section II of the ASME Boiler and Pressure Vessel Code. Low-melting-point materials of construction, such as aluminum and brass, shall not be used for LPG vessels.

4.14.5 Vessel Connection

The number of penetrations in any vessel shall be minimized, particularly those located below the working liquid level (i.e., below the vapor space). Flange connections shall be a minimum of ASME Class 150. All fittings shall be a minimum of NPS Y4.

PREVIOUSLY CONSTRUCTED VESSELS API 510 shall be used where an existing vessel is to be relocated or reused in a new service.

4.15 Sitting Requirements and Spill Containment

4.15.1 Siting

General- site selection is meant to minimize the potential risk to adjacent property presented by the storage facility and the risk presented to the storage facility by a fire or explosion on adjacent property. The following factors shall be considered in site selection:

a. Proximity to populated areas.
b. Proximity to public ways.
c. Risk from adjacent facilities.
d. Storage quantities.
e. Present and predicted development of adjacent properties.
f. Topography of the site, including elevation and slope.
g. Access for emergency response.
h. Availability of needed utilities.
i Requirements for the receipt and shipment of products.
j. Local codes and regulations.
k. Prevailing wind conditions.

A more likely LPG incident, and in the context of this publication a more relevant one, is leakage from piping or other components attached to or near the vessel followed by ignition, a flash fire or vapor cloud explosion, and a continuing pool fire and pressure (torch) fire.

With the exception of spacing, the design features discussed in these specifications are intended to prevent a major incident. Spacing is intended to minimize both the potential for small leak ignition and the exposure risk presented to adjacent vessels, equipment, or installations in case ignition occurs. Spacing is not intended to provide protection from a major incident.

Safety analysis and dispersion modeling are useful tools in estimating setback distances to limit the exposure risk to adjacent facilities.

4.15.2 Minimum Distance Requirement

The minimum horizontal distance between the shell of a pressurized LPG tank and the line of adjoining property that may be developed shall be as shown in Table l. Where residences, public buildings, places of assembly, or industrial sites are located on adjacent property, greater distances or other supplemental protection shall be provided.

The minimum horizontal distance between the shell of a pressurized LPG tank and the shell of any other pressurized hazardous or flammable storage tank shall be as follows:

a. Between two spheres, between two vertical vessels, or between a sphere and a vertical vessel, 5 ft or half of the diameter of the larger vessel, whichever is greater.
b. Between two horizontal vessels, or between a horizontal vessel and a sphere or vertical vessel, 5 ft or three quarters of the diameter of the larger vessel, whichever is greater.

The minimum horizontal distance between the shell of a pressurized LPG tank and the shell of any other non-pressurized hazardous or flammable storage tank shall be the largest of the following with the exception noted after Item d:

a. If the other storage is refrigerated, three quarters of the greater diameter.

b. If the other storage is in atmospheric tanks and is designed to contain material with a flash point of 100°F (37.7778^{0}C) or less, one diameter of the larger tank.

c. If the other storage is in atmospheric tanks and is designed to contain material with a flash point greater than 100°F (37.7778^{0}C), half the diameter of the larger tank.

The minimum horizontal distance between shells need not exceed 200 ft.

The horizontal distance between the shell of an LPG tank and a regularly occupied building shall be as follows:

a. If the building is used for the control of the storage facility, 50 ft.

b. If the building is used solely for other purposes (unrelated to control of the storage facility), 100 ft.

c. Compliance with API 752 may be used in lieu of the requirements in paragraph a and b.

The minimum horizontal distance between the shell of an LPG tank and facilities or equipment shall be as follows:

a. For process vessels, 50 ft.
b. b. For flares or other equipment containing exposed flames, 100 ft.
c. c. For other fired equipment, including process furnaces and utility boilers, 50 ft.
d. d. For rotating equipment, 50 ft; except for pumps taking suction from the LPG tanks, 10 ft.
e. e. For overhead power transmission lines and electric substations, 50 ft. In addition, siting shall be such that a break in the overhead lines shall not cause the exposed ends to fall on any vessel or equipment.
f. f. For loading and unloading facilities for trucks and railcars, 50 ft.
g. g. For navigable waterways, docks, and piers, 100 ft.
h. h. For stationary internal combustion engines, 50 ft.

The minimum horizontal distance between the shell of an LPG tank and the edge of a spill containment area for flammable or combustible liquid storage tanks shall be 10 ft.

Note: If the spill containment is by the use of dikes or walls, the edge of the spill containment area for the purpose of spacing is defined as the centerline of the dike or wall. If the spill containment is by sloping, grading, or channels, the edge of the spill containment area for the purpose of spacing is defined as the outer edge of the wetted area at the design incident for the spill containment facility.

Water Capacity of Each Tank (gallons)	**Minimum distance (Feet)**
2,000-30,000	50
30,001-70,000	75
70,001-90,000	100
90,001-120,000	125
120,00I or greater	200

Table 4.1 : Minimum Horizontal Distance Between Shell of Pressurized LPG Tank and Line of Adjoining Property That May Be Developed

4.15.3 Siting of Pressurized LPG Tanks and Equipment

Pressurized LPG tanks shall not be located within buildings, within the spill containment area of flammable or combustible liquid storage tanks as defined in NFPA 30, or within the spill containment area for refrigerated storage tanks.

Compressors and pumps taking suction from the LPG tanks should not be located within the spill containment area of any storage facility unless provisions are made protect the storage vessel from the potential fire exposure. Examples of such examples include

(a) a submerged-motor, direct-coupled pump with no rotating element outside of the pump containment vessel;

(b) a submersible pump inside an LPG tank.

Horizontal LPG tanks with capacities of 12,000 gallons or greater shall not be formed into groups of more than six tanks each. Where multiple groups of horizontal LPG vessels are to be provided, each group shall be separated from adjacent groups by a minimum horizontal shell-to-shell distance of 50 ft.

Note: Horizontal vessels used to store LPG should be oriented so that their longitudinal axes do not point toward other facilities (such as containers, process equipment, control rooms, loading or unloading facilities, or flammable or combustible liquid storage facilities or offsite facilities located in the vicinity of the horizontal vessel).

4.16 Drainage

The ground under and surrounding a vessel used to store LPG shall be graded to drain any liquid spills to a safe area away from the vessel and piping. The grading shall be at a slope of at least 1%.

The drainage system shall be designed to prevent liquid spilled from one tank from flowing under any other tank and shall minimize the risk to piping from spilled LPG.

The spill drainage area shall not contain equipment, except as permitted by this specifications.

Walls, dikes, trenches, or channels are permitted to assist in draining the area.

4.17 Spill Containment

Spill containment shall be considered for all locations and provided in locations in which either of the following conditions will result in a significant hazard:

a. The physical properties of the stored LPG make it likely that liquid LPG will collect on the ground. (This would be the case if the LPG is a mixture of butane and pentane.)

b. Climatic conditions during portions of the year make it likely that liquid LPG will collect on the ground.

The following shall be considered in the selection of materials for all components-including structural supports of a spill containment facility:

a. The effects of thermal shock associated with spilling LPG (such as shock resulting from the auto refrigeration temperature).

b. Provision of adequate venting of the vapor generated during an LPG spill.

If spill containment is to be provided, it shall be by remote impoundment of spilled material or by diking of the area surrounding the vessel. The containment area shall not contain any other equipment, except as permitted by this standard.

If the floor of any spill containment area will not allow rainwater to dissipate within 24 hours, a drainage system shall be installed. Any drainage system provided shall include a valve or shear gate located in an accessible position outside the spill containment area. The valve or shear gate shall normally be kept closed. The drainage system shall be one of the following types:

a. A vapor sealed catch basin within the spill containment area discharging to a closed drainage system outside the spill containment area.

b. A pipe through the dike or wall discharging to a drainage system outside the spill containment area. The drainage system shall keep the contents of the tank from entering natural water courses and from entering systems incapable of safely containing LPG.

4.18 Remote Impoundment

If remote impoundment is to be used for spill containment, the remote impoundment facility shall be designed according to the requirements given below:

- Grading of the area under and surrounding the vessels shall direct any liquid leaks or spills to the remote impoundment area. Grading shall be at a minimum of 1% slope.
- The use of walls, dikes, trenches, or channels to facilitate the draining of the area is permitted.
- The remote impoundment area shall be located at least 50 ft from the vessels draining to it and from any hydrocarbon piping or other equipment.
- The holdup of the remote impoundment area shall be at least 25% of the volume of the largest vessel draining to it. If the material stored in the vessel has a vapor pressure that is less than 100 psia at 100°F(37.7778^{0}C), the holdup for the remote impoundment facility shall be at least 50% of the volume of the largest vessel draining to it. Larger holdUps shall be provided in the remote impoundment facility at locations where the expected vaporization is less than that indicated by the material's vapor pressure because of climatic conditions or the physical properties of the material.

4.19 Diking

If diking around the vessel is to be used for spill containment, the diked area shall be designed according to the requirements given below:

- Grading of the area under and surrounding the vessels shall direct any liquid leaks or spills to the edge of the diked area. Grading shall be at a minimum of I % slope. Within the diked area, grading should cause spills to accumulate away from the vessel and any piping located within the diked area.
- If an LPG sphere is diked, each sphere shall be provided with its own diked area. If LPG is stored in horizontal vessels, a single diked area may serve a group of tanks.
- The holdup of the diked area shall be at least 25% of the volume of the largest vessel within it. If the material stored in the vessel has a vapor pressure that is less than 100 psi at 100°F, the holdup for the diked area shall be at least 50% of the volume of the largest vessel within it. Larger holdups shall be provided in the diked area at locations where the expected vaporization is less than that

indicated by the material's vapor pressure because of climatic conditions or the physical properties of the material. Note: Larger holdups may also be provided when more than one vessel is located within the same diked area.

- When dikes or walls are used as part of the spill containment system, the minimum height of a dike or wall constructed of earth shall be 1.5 ft and the minimum height of a dike or wall constructed of concrete, masonry, or another erosion-resistant material shall be I ft. Provisions shall be made for normal and emergency access into and out of the diked enclosure. Where dikes must be higher than 12 ft or where ventilation is restricted by the dike, provision shall be made for normal operation of valves and access to the top of the tank or tanks without the need for personnel to enter into the area of the diked enclosure that is below the top of the dike. All earthen dikes shall have a flat top section not less than 2 ft wide.
- Any dike or wall enclosure used for LPG containment shall include adequate access provisions (such as stairs for personnel and ramps for vehicles, if required), shall be designed to permit its free ventilation, and shall be constructed to retain the spilled liquid. Enclosures shall be designed to prevent unauthorized access by motor vehicles.

4.20 Foundations and Supports for LPG Storage Vessels and Related Piping

4.20.1 Applicable Codes and Specifications

The materials, principles, methods, and details of design and construction of foundations and supports for LPG storage vessels and related piping shall meet the requirements stipulated in the following codes and specifications:

a. For concrete, ACI 318.
b. For masonry, ICBO Uniform Building Code.
c. For structural steel, AISC Specification for Structural Steel Buildings. Where applicable local codes are more stringent, the local codes shall apply.

4.20.2 Special Requirements

Generally the foundation and supports shall conform to the provisions set forth below:

- Materials supporting structures shall be made of one or a combination of the following materials:

a. Reinforced masonry.
b. Reinforced concrete.
c. Steel plate, pipe, or structural shapes.

- Soil Information

The design of the foundation shall be based on a thorough knowledge of the load-bearing capacity and settlement properties of the soil. Where information regarding soil conditions is not available, an investigation shall be conducted.

- Settlement of Foundation

The size and depth of the foundation shall be designed to limit settlement of the vessel to prevent excessive stresses in the tank and connected piping. Note: Settlement should be monitored during the hydrotest.

- Bottom of Foundation

The bottom of the foundation shall be below the frost line and below nearby sewers or lines having the potential for leakage or washout that could result in settlement of the foundation.

- Floating Foundation or Piling

Where it is impracticable to design foundations for normal settlement as described above, a floating foundation or piling is permitted. In this case, the settlement indicated by soil tests shall be used for design, and the settlement measured during subsequent service shall be used to check for adequate flexibility in connected piping.

- Loads on Supporting Structure

The following loads shall be considered in the design of the supporting structure:
a. Static loads during erection plus expected wind, loads during the erection.
b. Static loads during water testing plus 25% of the wind loads.
c. Static loads during operation (including the load due to fireproofing) plus applicable combinations of wind, ice, snow, and earthquake loads.
d. Loads resulting from expansion and contraction of the vessel due to internal pressure and temperature changes.
e. Loads resulting from differential settlement across the supporting structures and foundations.
f. Static and dynamic loads during maintenance and operations.

- Support Design

The design of supports for vessels shall include provisions for expansion and contraction of the vessel due to internal pressure and temperature change of the vessel shell.
Flexibility shall be provided in the attached piping to avoid imposing excessive stress on vessel nozzles and associated piping as a result of vessel movement. Note: The following publication contains additional material regarding the design of supports: Section VIII of the ASME Boiler and Pressure Vessel Code.
Pressure retaining portions of storage vessels should typically not contact concrete or masonry supports or concrete or masonry fireproofing, since these contact points may be sites for external corrosion. If such contact points are present, they should be identified for routine inspection.

4.20.3 Vessel Shell Loads

In the design of vessel supports, special attention shall be given to the loads imposed on the vessel shell. Consideration shall be given to the following:
a. Secondary forces resulting from service temperatures or changes in temperatures.
b. Test and operating pressures.
c. Liquid loads, both with and without pressure applied.
d. Loads due to piping reactions.
e. Normal supporting loads.
f. Loads due to liquid sloshing (in earthquake zones).

4.20.4 Diagonal Members

Diagonal members, such as those used for bracing vertical columns, shall not be attached directly to a vessel unless adequate provisions are made for the resulting loads in the design of the vessel.

4.20**.5 Saddles**

When a horizontal tank is supported by saddles, the features specified below shall be incorporated in the design:

- Two piers shall be used to support horizontal vessels.
- Consideration shall be given to the placement of supports to obtain the most desirable stress distribution in the vessel shell.
- The shape of the saddles shall conform to the fabricated shape of the vessel or to the steel pad attached to the vessel.
- Doublers or reinforcing plates may be installed between the vessel shell and the supports to avoid external corrosion of the shell, provide for wear caused by temperature-induced movement, or reduce the stress in the shell at the support points. If such plates are used, they shall be continuously welded to the vessel shell after any free moisture is removed from under the plates. A threaded weep hole shall be provided at the low point of each plate. Where corrosion plates are used, the plates shall extend beyond the limits of the supporting saddles to aid in distributing the support loads. The thickness of corrosion plates shall not be included in calculating the stress at the hom of the saddle.

4.20.6 Multiple Vessels

Continuous footings may be used for multiple vessel installations. In such instances, the loading of footings shall be calculated for various probable combinations of loads, such as the load that occurs when adjacent vessels are full and the load that occurs when alternate vessels are full.

Continuous piers shall not be used for multiple vessel installations without the incorporation of special drainage provisions.

4.20.7 Anchorage

- In areas where there is a risk of flooding, the vessel shall be anchored to the foundation or support to prevent floating in case of a flood. Anchorage shall not restrict vessel movements resulting from expansion and contraction of the vessel due to temperature changes and internal pressure.
- Anchorage of the vessel to the foundation or support shall be provided to resist wind and earthquake loads and to control temperature-induced movement.
- Anchorage to the foundation or support shall be provided to resist any uplifting forces resulting from internal pressure in the tank or vessel.

4.20.8 Vertical Tank Skirts

- Where vertical vessels are supported by skirts, the skirts shall be provided with a single opening for inspection or access. The opening shall be as small as practicable.
- Skirt openings shall be reinforced when required to prevent buckling or overstressing of the skirt as a result of imposed loads.

4.20.9 Corrosion Protection

- Steel supports and their members shall be positioned to prevent the accumulation of water. Where this positioning is impractical, adequate drainage openings shall be provided to prevent such accumulation.
- Enclosed spaces in which water might accumulate during construction or operation shall be provided with drainage openings.

4.21 Tank Accessories, Including Pressure and Vacuum-Relieving Devices

4.21.1 Mandatory Equipment

Equipment shall be suitable for use with LPG and designed for at least the maximum service conditions to which it may be subjected. General Tanks shall be fitted with the equipment described below:

i.) Liquid-Level Gauging Equipment

Each LPG tank shall be provided with liquid-level gauging equipment as specified below:

- Each tank shall be equipped with a reliable level indicating system. The need for a second, independent level indicating system shall be determined by a safety analysis.
- An independent high-level alarm shall be provided. The alarm shall be set to give the operator sufficient time to stop the flow before the maximum permissible filling height is exceeded. The alarm shall be located so that it is audible and visible to the operating personnel controlling the filling operation.
- For tanks that cannot be removed from service, provisions shall be included for testing, repairing, and replacing primary gauges and alarms while the tank is in service.
- In tanks that have a high-level cutoff, the cutoff device shall be in addition to and independent of the high level alarm specified

4.21.2 Maximum Liquid Level

The maximum permissible filling height of an LPG tank shall be set to provide adequate vapor space to accommodate any thermal expansion that may occur after filling is completed. The maximum filling height shall be set so that when a tank filled to that level at the minimum anticipated storage temperature the thermal expansion of the liquid will not cause the LPG level to exceed 98% of the liquid full level.

4.21.3 Level Gauges

Columnar glass level gauges shall not be used. Reflex and see-through level gauges shall be equipped with a ball check valve or a similar protective device.

4.21.4 Pressure Gauge

On each tank, a suitable pressure gauge should be considered. When used it should be connected to the vapor space.

4.21.5 Pressure- and Vacuum-Relieving Devices

7.1.6.1 Generally each tank shall be provided with one or more spring-loaded or pilot-operated pressure relief valves. The pressure relief valve or valves shall be set to discharge as required by the ASME Code. Pilot-operated pressure relief devices shall be designed so that the main valve will open automatically and protect the tank if the pilot valve fails. Pilot-operated valves shall be provided with a backflow preventer if the possibility exists that the internal pressure can drop below atmospheric. Tanks that may be damaged by internal vacuum shall be provided with vacuum-relieving devices. Weight and lever pressure-relieving devices shall not be used.

4.21.6 Pressure Relief Valve Flow Capacities

Pressure relief valves installed on LPG tanks shall be designed to provide adequate flow capacity to protect the tank during fire exposure. Other causes of tank overpressure, such as overfilling and introduction of material with a higher vapor pressure in a common piping system, shall be considered in determining design flow capacity. Pressure relief valves shall be designed and sized in accordance with API RP 520, Part I, and RP 521.

4.21.7 Pressure Relief Valve Information

Each pressure relief valve shall be marked as required by the applicable AS ME code, API standard, or API recommended practice.

4.21.8 Pressure Relief Valve Installation

Pressure relief valves shall be installed in accordance with API RP 520, RP 521, and the following requirements:

- The pressure relief valve shall be installed to provide direct connection to the vapor space and to minimize liquid carry-over during vapor relief, especially when the tank is nearly full. This shall be achieved by locating the pressure relief valve connections as close as practical to the top of the vapor space.
- The possibility of tampering with the adjustment mechanism shall be minimized. If the adjustment mechanism is external, it shall be sealed.
- The inlet and outlet piping for the pressure relief valve shall be designed to pass the rated capacity of the valve without exceeding the allowable pressure-drop limits.
- The pressure relief system shall be protected from the closure of any block valves installed between the tank and the pressure relief valve or between the pressure relief valve and its discharge vent outlet. This protection may be achieved by one of the following procedures:
  a. Installing the pressure relief valve without block valves.
  b. Providing excess pressure relief valve capacity with multi-way valves, interlocked valves, or sealed block valves arranged so that isolating one pressure relief valve will not reduce the capacity of the system to below the required relieving capacity.
  c. Locking or sealing the block valves open without installing excess relieving capacity, as follows. The valve seals or locks should be checked routinely to assure they are in place and locks are operable. The valves shall be closed by

an authorized person who shall remain stationed in audible and visual contact with the vessel, and in a position to correct or arrest potential overpressure events while the valves are closed and the tank is in operation and shall lock or seal the valves open before leaving. The authorized person shall be able to observe the operating pressure while the valves remain blocked and shall be ready to take emergency action if required.

- The stem of any gate valve installed in the pressure relief system shall be in a horizontal or below-centerline position.

4.21.9 Discharge Vents

Discharge vents from the pressure relief valves or common discharge headers shall be designed to meet the requirements of API RP 520 and RP 521 and shall be installed in accordance with the requirements given below:

- Discharge vents shall lead to the open air or to a flare system. Discharging directly to the atmosphere is unacceptable if liquid LPG might be released into the atmosphere, unless the discharge is through thermal relief valves. Positive design and operational steps shall be taken to prevent the discharge of liquid LPG from atmospheric vents. Such steps include automatic shutdown of filling operations prior to overfilling.
- Discharge vents shall be protected against mechanical damage.
- If discharge vents relieve to the atmosphere, they shall be designed to prevent entry of moisture and condensate. This design may be accomplished by the use of loose-fitting rain caps and drains. Drains shall be installed so that the discharge will not impinge on the tank or adjoining tanks, piping, equipment, and other structures.
- Discharge vents shall be designed to handle any thrust developed during venting. Discharge shall not be less than 3 m (10ft) above the operating platform.
- Discharge shall be to an area that has the following characteristics: a. The area prevents flame impingement on tanks, piping, equipment, and other structures. b. The area prevents vapor entry into enclosed spaces. c. The area is above the heads of any personnel on the tank, adjacent tanks, stairs, platforms, or the ground.

4.21.10 Pressure Setting

Pressure relief valves shall be tested for correct set pressure before being placed in service.

i. Shutoff Valves

- Shutoff valves shall conform to the criteria specified below
- Shutoff valves shall be provided for all tank connections except the following:
  a. Connections on which safety valves are mounted.
  b. Connections containing a Ilk-inch-maximum restriction orifice, plugs, or thermometer wells.
- Shutoff valves shall be located as close to the tank as is practical. The preferred location is at the shell nozzle. Shutoff valves shall be readily accessible for operation and maintenance.

- Shutoff valves shall conform to the material and construction requirements of 8.6.
- All shutoff valves located on nozzles below the maximum liquid level shall be designed to provide a visual indication of the valve position and shall be capable of maintaining an adequate seal under fire conditions. Valves meeting the requirements of API Std 607 or Spec 6FA have the required fire resistance.
- When the capacity of the vessel exceeds 10,000 gallons, all shutoff valves on inlet and outlet piping located below the maximum liquid level shall either close automatically or be remotely operable during the first 15 minutes of fire exposure. This may require fireproofing of the control system. These valves shall also be manually operable at the installed location. Check valves installed on dedicated fill lines are suitable for meeting the requirements of this paragraph.

4.21.11 Temperature Indicator
Each tank shall be fitted with a suitable thermometer well.

4.22 Tank Accessory Materials
Ductile (nodular) iron, cast aluminum, malleable iron, and brass shall not be used in any pressure-retaining tank accessories.

4.23 Piping Requirements
AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE FOR PRESSURE PIPING-Piping at facilities covered under this standard shall conform to the provisions of ASME 831.3; except that piping that falls under the exclusion provided in 300.1.3(e) of ASME B31.3 shall be constructed in accordance with the provisions of ASME B31.4. The additional provisions of this section apply to piping constructed in accordance with ASME B31.3.

4.23.1 LPG Piping
Recommended Pipe Piping shall be seamless, electric-resistance-welded, or submerged-arc-welded pipe. Pipe to be used in piping applications of 2 in. or smaller shall be seamless.

4.23.2 Piping Joints
The number of joints of any type between the vessel and the first block valve shall be minimized.

- Welded joints shall be used where practical.
- The number of flanged joints shall be minimized.
- Joints in pipe NPS 2 or larger shall be welded or flanged.
- Joints in pipe smaller than NPS 2 shall be socket-welded, butt-welded, or flanged.
- Piping gaskets shall be of the self-centering or confined type and shall be resistant to LPG.
- Threaded connections shall be minimized to the extent practicable and shall be between NPS 3/4 and NPS 1/2, inclusive. Note: Threaded connections are typically used for connections such as instrumentation and specialty devices and are downstream of a block valve.

4.23.3 Minimum Specifications

- The pipe wall thickness shall be equal to or greater than that required by ASME 831.3. The minimum requirements specified below shall also apply.
- Pipes made from materials subject to brittle-failure, such as carbon steel, shall have the following minimum wall thicknesses:
  a. Nominal pipe size less than NPS 2-Schedule 80.
  b. NPS 2-5-Schedule 40 (except for threaded connections, which shall be Schedule 80).
  c. NPS 6-wall thickness of 0.25 NPS.
  d. NPS 8-12-Schedule 20.
  e. NPS 14 or larger-Schedule 10.
- Pipes made from materials not subject to brittle failure, such as stainless steel, shall have the following minimum wall thicknesses:
  a. NPS 3/4 or less-Schedule 80S.
  b. NPS 1, ['/2, or 2-Schedule 40S.
  c. NPS larger than 2-Schedule lOS.

4.23.4 Pressure Tubing

Tubing shall be constructed of steel. If tubing will be exposed to a corrosive atmosphere, stainless steel shall be used.

4.24 Fittings

4.24.1 Butt-Welding Fittings

Butt-welding fittings shall be made from seamless steel or equivalent material, shall be of at least the same thickness and schedule as the piping, and shall conform to ASME B 16.9.

4.24.2 Socket-Welding Fittings

Socket-welding fittings 2 in. or smaller in size, such as elbows, tees, and couplings, shall be of forged steel and shall have a working pressure of at least 2000 psi.
Packed-Sleeve and resilient-sealed Couplings Packed-sleeve and resilient-sealed couplings shall not be used.
Flanges Weld-neck flanges are preferred. Socket-wield NPS 2 and smaller are acceptable. If slip-on flanges are used, they shall be welded both inside and outside.

4.24.3 Plugs

Plugs shall be constructed of steel.

4.25 Unions

Unions shall be of forged steel, shall have a working pressure of at least 3000 psi, and shall have ground metal-to-metal seats. Gasket unions shall not be used. Unions shall not be used between the vessel and the first valve.

4.26 Valves

4.26.1 Primary Shutoff Valves

The primary shutoff valves for a tank (specifically the valves nearest the vessel that can shut off flow) shall be made from steel. Valves constructed of free-machining steel similar to AISI Series 1100 and 1200 shall not be used.

Union or screwed-bonnet valves shall not be used unless they are equipped with bonnet retainers or the bonnets are tack welded.

Valves that are sandwiched between two flanges by long, exposed bolts shall not be used, unless the valves have lug-type bodies that cover the bolts.

Ball valves shall meet the requirements of API Std 607.

4.26.2 Check Valves

Check valves shall be installed on the discharge side of all centrifugal pumps.

4.26.3 Pressure Relief Valves

Pressure relief valves shall be contacted of steel.

4.26.4 Thermal Relief Valves

Suitable thermal relief valves shall be considered on liquid lines that can be blocked between two shutoff valves. Other equipment that can be blocked between shutoff valves shall be provided with protection from overpressure due to thermal expansion of the liquid. Where liquid is trapped in valve cavities, the need for pressure relief shall be considered.

4.27 Location, Installation, and Flexibility of Piping, Valves and Fittings

Piping shall be provided with adequate flexibility to accommodate the following:

a. Settling of tanks or shifting of foundations.

b. Expansion or contraction of tanks or piping with changes in temperature.

c. Soil movement.

d. Cooling or heating of unloading connections, vent connections, or loading and unloading headers.

- Headers located on piers shall be designed to permit unrestrained movement of the piping in the direction of expansion or contraction except at necessary anchor points.
- All water drawoffs shall be extended so that they do not terminate under the vessel. Drain lines shall not be directed into a public sewer or into a drain not designed to contain flammable materials. Double valves shall be provided. When drain lines are supported by any type of support not directly attached to the tank, adequate flexibility shall be provided in the lines to accommodate differential settlement. Stress imposed on the vessel nozzle by the drain lines shall be minimized.
- Water drain lines and similar small lines shall be adequately supported or shall be fabricated with sufficient strength to be self-supporting under operating conditions, including the condition of maximum flow reaction thmst. Stress imposed on the vessel by the drain lines shall be minimized.

- Freeze protection shall be considered for all drain lines and potential water collection points. Abnormal operating conditions, such as might occur during abnormally cold weather, should be considered where water might collect and freeze protection is needed.

4.28 Loading, Product Transfer, and Unloading to Facilities

4.28.1 Pumps

Pumps may be centrifugal, reciprocating, gear, submersible or may be another type designed for handling LPG. The design pressure and construction material of the pumps shall be capable of safely withstanding the maximum pressure that could be developed by the product, the transfer equipment, or both. When centrifugal pumps are used, mechanical seals are recommended. Positive displacement pumps shall have a suitable relief device on the discharge side unless other provisions are made for protection of the equipment.

When submersible pumps are used, each interface between the LPG system and an electrical conduit or wiring system shall be sealed or isolated to prevent passage of LPG to another portion of the electrical installation. See NFPA 59A for further information.

4.28.2 Compressors

Compressors for loading and unloading LPG shall be designed for the maximum outlet pressure to which they may be subjected. Each centrifugal compressor discharge connection shall be equipped with a check valve. Each centrifugal compressor shall be evaluated for conditions that may cause overpressure, and a relieving device shall be provided if required. Each positive displacement compressor shall be equipped with a pressure-relieving device on the discharge side. A suitably sized scrubber or liquid knockout drum shall be installed immediately upstream of vapor compressors. The scrubber shall be equipped with a high-liquid-level device to shut down the compressor.

4.28.3 Pressure Gauges

Pressure gauges shall be provided in enough locations in the liquid and vapor lines to enable the operator to monitor operating pressure and pressure differentials constantly to ensure safe operation.

4.28.4 Emergency Shutoff Valves

Emergency shutoff valves shall be provided in the loading-unloading system for tank cars, trucks, and marine facilities and shall incorporate the following means of closing:

a. Manual shutoff' at the installed location.

b. Manual activation from a location accessible during an emergency. A safety analysis shall be the basis for determining the need for the following:

a. Automatic shutoff' in the event of an LPG release.

b. Automatic shutoff through thermal (fire) actuation.

Installation practices for emergency shutoff' valves shall include those specified below:

- When hose or swivel piping is used for liquid or vapor transfer, an emergency shutoff valve shall be installed in the fixed piping of the transfer system within 20 linear ft of pipe from the end to which the hose or swivel piping is connected. Where the flow is in one direction only, a check-valve may be used in place of an

emergency shutoff' valve if the check valve is installed in a dedicated storage vessel fill line or vapor return line. When two or more hoses or swivel piping arrangements are used, either an emergency shutoff valve or a check-valve (for unloading lines only) shall be installed in each leg of the piping. Note: If check valves are used in place of emergency shutoff valves, the owner/operator should have a program to assure the reliability of these devices.

- The emergency shutoff valves or backflow check valves shall be installed in the fixed piping so that any break resulting from a pull will occur on the hose or swivel piping side of the connection while the valves and piping on the plant side of the connection remain intact. This may be accomplished by the use of concrete bulkheads or equivalent anchorage or by the use of a weakness or shear fitting. Refer to NPGA Bulletin 128.
- Facility boundary limit block valves and check valves shall be provided if the feed or product is transported by pipeline. If block valves are manually operated, they shall be accessible during an emergency.

4.29 Grounding and Bonding

Static Electricity Protection from discharge of static electricity is not required when a tank car, a tank truck, or marine equipment is loaded or unloaded through tight (top or bottom) outlets using a conductive or nonconductive hose, flexible metallic tubing, or pipe connection because no spark gap exists while product is flowing (see API RP 2003).

4.29.1 Stray Currents

If stray currents are present or if impressed currents are used on the loading and unloading systems for cathodic protection, protective measures shall be taken in accordance with API RP2003.

Lightning Protection Aboveground metallic LPG storage containers do not require lightning protection. To protect personnel and foundations where the piping might not provide grounding, grounding rods shall be provided for tanks supported on nonconductive foundations.

4.30 Hose and Other Flexible Connectors for Product Transfer

4.30.1 Hose

Hose shall be fabricated of materials resistant to LPG in both liquid and vapor form. If wire braid is used for reinforcement, it shall be made from corrosion-resistant material such as stainless steel.

- The correctness of design, construction, and performance of hose shall be determined. Only hose listed by Underwriters Laboratories or another nationally recognized testing laboratory shall be used for LPG transfer applications. Hose used in marine applications shall be approved by the U.S. Coast Guard.
- Hose, hose connections, and flexible connectors used for transferring LPG liquid or vapor at pressures in excess of 5 psig shall conform to the criteria specified below.

- Hose shall be designed for a minimum working pressure of 350 psig and a minimum bursting pressure of 1750 psig. Hose shall be marked "LPG" or "LP-gas" at intervals of not more than 10ft.
- After the installation of connections, hose assemblies shall be tested to a pressure not less than 700 psig.
- Hose assemblies shall be visually inspected before each use for damage or defects. Hose assemblies shall be tested at least annually at whichever is greater, the maximum pump discharge pressure or the relief valve setting.
- Hose Protection Hose shall be protected from the elements and physical damage. Particular attention shall be given to the prevention of potentially damaging ice formation on the corrugations of metallic hose.
- Support of Loading Arms or Hoses Provisions shall be made for adequately supporting the loading hose or arm. The weight of ice formations on uninsulated hoses or arms shall be considered in the design of counterweights.
- Flexible Pipe Connection Each flexible pipe connection shall be capable of withstanding a test pressure of 11/2 times the design pressure for its part of the system.

5.0 PUBLIC PARTICIPATION

5.1 Introduction

The planned LPG plant is likely to have some impacts on the surrounding areas. Stakeholders, interested parties and the general public within and around the project site were interviewed so that they could shed some light on their expectations from the planned project. The purpose for such interviews was to identify and promote the positive impacts while mitigating the negative ones. It also helped in identifying any other miscellaneous issues which may bring conflicts in case project implementation proceeds as planned. The exercise was conducted by a team of experienced registered environmental experts via administration of pre-designed questionnaires.
The responses from the questionnaire survey are attached in **Appendix 8**

5.2 Data collection

The data collection was carried out by use of interview schedules and distribution of questionnaires to the stakeholders around the site. Observation and photography was also used in gathering information about the area in relation to the proposed project.

5.3 Issues of concern

Various concerns were raised by neighbours about the proposed LPG facility. While there were concerns; no one opposed the project implementation but rather they all asked the proponent to adhere to best practices and avoid many negative impacts. Some of the issues raised were as follows:

(i) Noise and Air pollution

There was concern that there would be a lot of noise during the construction and operations activities and loading/offloading of cylinders. Some also expressed concerns about air pollution from gas smell.

(ii) Fire Risk

Some residents raised concerns about fire risk due to the nature of the gas and asked for precautions to be put in place.

(iii) Emissions

There was also concerns that there could be negative effects of dust emissions and diesel engine emissions that may be detrimental to the residents health.

(iv) Solid waste

Some of the neighbours felt that proper measures should be taken to reduce solid waste and its management..

There were also some who saw positive impacts of the project and among those cited were:

(i) Employment opportunities for locals

(ii) Improved living standards

(iii) Saving trees from being chopped
(iv) Economic boost to the area
(v) Cheaper LPG gas for the locals

6.0 ENVIRONMENTAL IMPACTS OF THE PROJECT AND MITIGATION

6.1 Introduction

Identification of impacts and mitigation measures of the same in Environmental Impact Assessment study helps in quantification and evaluation of impacts. During baseline study several impacts can be identified but it is necessary to identify the critical impacts both positive and negative on various components of the environment that are likely due to installation of LPG storage tanks.

The environmental impacts can be categorized as either primary or secondary. Primary impacts are the ones that are caused directly due to the project activity on environmental attributes, whereas secondary impacts are indirectly induced.

The construction and operational phase of the project activity comprises various activities, each of which may have either positive or negative impact on some or other environmental attributes. The proposed project activities would impart impact on the environment in two distinct phases:

During construction phase - Temporary or short term impact
During operation phase - May have long term impact

6.2 Impact Assessment

6.2.1. During Construction Phase

6.2.1.1 Identified Impacts on Land/Soil Environment

During site preparation, excavation will be done at places in the project site where sheds, Storage bullets and the approach road will be constructed. This is required to provide solid base/foundations for structures & roads.

- Improper disposal of the excavated earth during installation of storage tanks /structures may result into temporary loss of topsoil productivity of that particular area.
- Storage of construction material/chemicals (if any) if not done at designated place can cause nuisance and hazards
- Accidental spillage of Hazardous chemicals/oil during handling may lead to soil contamination
- Improper segregation and disposal of solid waste generated during construction phase by workers working at site

- Garbage generation if dry waste/garbage generated during construction period is not handled efficiently

6.2.1.2 Identified Impacts on Air Environment

- The emission anticipated during construction period will include fugitive dust due to excavation of soil, leveling of soil, use of DG sets, movement of heavy construction equipments/vehicles, site clearing and other activities
- This type of fugitive dust is expected to result in change in the baseline air quality specifically during the construction phase
- If burning of solid wastes is required it may cause air pollution

6.2.1.3 Identified Impacts on Noise Environment

The proposed project will lead to emission of noise that may have significant impact on the surrounding communities in terms of increase in noise levels and associated disturbances.

Following activities could result in increase in noise level;

- Noise generated from operation of pumps and blower
- Noise generated from vehicular movement
- Noise generated from DG Set
- Nuisance to nearby areas due to noise polluting work at night

6.2.1.4 Identified Impacts on Water Environment

- Increased water demand during construction phase for site preparation, dust spraying, construction activities, curing, domestic and other water requirements for labour and staff onsite
- Increase in site runoff and sedimentation
- Stagnant water and unsanitary conditions may cause mosquito breeding at site

6.2.1.5 Identified Impacts on Socio-Economic Environment

- The proposed project does not involve any displacement of inhabitants for the construction of LPG Bottling Plant.
- Construction phase could lead to creation of employment and procurement opportunities.

- A multiplier effect will be felt on the creation of indirect employment through the local community establishing small shops like tea stalls, supply of intermediate raw materials, repair outlets, hardware stores garrages etc.
- Self- employment options for individuals possessing vocational or technical training skills like electricians, welders, fitters etc, which are likely to be sourced locally;
- There could be influx of workers during construction phase which could lead to pressure on key local infrastructure such as water, healthcare, electricity.
- The construction activity could lead to increased nuisance level from air emissions and noise due to transportation of material and equipment as well as labourers.
- The construction activity could also lead to water stagnation at pockets which may lead to breeding of mosquito and related health impacts.

6.2.2. During Operation Phase

6.2.2.1 Identified Impacts on Land/Soil Environment

- Soil quality may be affected by accidental leakage and spillage of hazardous chemicals/oils during handling
- Improper segregation and disposal of solid waste generated during operation of the proposed project

6.2.2.2 Identified Impacts on Air Environment

- No emission is envisaged during the storage and handling of LPG in storage bullets
- No fugitive emission during loading and unloading of LPG in and from mounded bullets is envisaged
- Impacts on ambient air during operation phase would be due to emissions from operation of DG sets only during power outages.

6.2.2.3 Identified Impacts on Noise Environment

- Impact of noise due to vehicular traffic
- Noise generated due to DG sets

6.2.2.4 Identified Impacts on Water Environment

- Stress on existing water supply
- Generation of waste water & domestic effluent
- Increased run off from site.

6.2.2.5 Identified Impacts on Socio-Economic Environment

- Project and associated construction of LPG Bottling Plant will eventually lead to permanent job opportunities in the organized and unorganized sector. There is likely to be increased demand for security, kitchen help, need for drivers etc.
- Development of physical infrastructure due to construction of the plant which could benefit the local population.

6.3 Impact Mitigation Measures

6.3.1. During Construction Phase

6.3.1.1 Land/Soil Environment Impact Mitigation Measures

- Top soil will be stored carefully and will be used again after construction/installation phase is over so as to restore the fertility of project site
- Bituminous materials / other chemicals, if any, shall not be allowed to leach into the soil
- Methods to reuse earth material generated during excavation will be followed
- Waste oil generated from D. G. sets will be handed over to authorized recyclers approved by NEMA
- Usage of appropriate monitoring and control facilities for construction equipments deployed
- All hazardous wastes shall be securely stored, under a shed for eventual transportation and disposal to the authorized dealers
- The solid waste generation due to workers working at site will be segregated and will be transported and disposed of to CGK waste disposal facility
- Chemicals/Paints etc. used during construction phase will be stored safely

6.3.1.2 Air Impact Mitigation Measures

- Checking of vehicles and construction machinery to ensure compliance to legal standards as prescribed in the traffic act
- Transportation vehicles, DG sets and machineries to be properly and timely maintained and serviced regularly to control the emission of air pollutants in order to maintain the emissions of NO_X and SO_X within the limits established by NEMA
- Minimize idling time for vehicles and adequate parking provision and proper traffic arrangement for smooth traffic flow

- Use of good quality fuel and lubricants will be promoted. Moreover, low sulphur content diesel shall be used as fuel for DG sets to control emission of SO_2
- Water sprinkling shall be carried out to suppress fugitive dust during earthworks and along unpaved sections of access roads
- Attenuation of pollution/ protection of receptor through strengthening of existing greenbelt/ green cover

However, the construction activities will be for temporary period and hence, its impact on the existing ambient air quality as well as vegetation will be reversible. Dust emissions are likely to be confined within the limited area.

6.3.1.3 Noise Impact Mitigation Measures

- Acoustic enclosures for DG Sets will be provided
- Pumps – Enclosure in acoustic screen, allowing for engine cooling and exhaust, use of anti-vibration mounting, flexible couplings of hoses, maintaining adequate inlet pressure
- Provision of Intake mufflers, unidirectional fan for Cooling and enclosures for electrical motors
- Provision of ear plugs for labour in high noise area
- Provision of barricades along the periphery of the site
- All contractors and subcontractors involved in the construction phase shall comply with acceptable noise standards
- Activities that take place near sensitive receptors to be carefully planned (restricted to daytime, taking into account weather conditions etc.)
- Vehicles and generator sets to be serviced regularly and maintained properly to avoid any unwanted generation of noise or vibration from them
- Use of suitable muffler systems/ enclosures/ sound proof glass paneling on heavy equipment/ pumps/ blowers
- Pumps and blowers may be mounted on rubber pads or any other noise absorbing materials
- In case of steady noise levels above 85 dB (A), initiation of hearing conservation measures
- Strengthening of greenbelt for noise attenuation may be taken up, etc.

6.3.1.4 Water Impact Mitigation Measures

- Water Avoidance of wastage of curing water
- Use of tanker water for construction activity.
- Provision of temporary toilets for labour
- Wastewater generated will be recycled/reused during operation of the LPG Plant

6.3.1.5 Socio-Economic Environment Impacts Mitigation Measures

- Employing local people for construction work to the maximum extent possible.
- Providing proper facilities for domestic supply, sanitation, domestic fuel, education, transportation etc. for the construction workers.
- Barricades, fences and necessary personnel protective equipment such as safety helmet, shoes, goggles, gloves, harness etc. will be provided to the workers and employees.
- Constructional and occupational safety measures to be adopted during construction phase of the industry.
- The health of workers will be checked for general illness; first time upon employment and thereafter at periodic intervals, as per the local laws and regulations.
- The workers will be diagnosed for respiratory functions at periodic intervals and during specific complaints etc. Medical Aid as per Factory Act and Panel doctor facility will be provided to the workers.
- Job rotation schemes will be practiced for over-exposed persons. Insignificant impact is expected on the workers health and safety during the operation phase stage.

6.3.2. During Operation Phase

6.3.2.1 Land/Soil Environment Impact Mitigation Measures

- Installation of drainage ditches at project site to prevent erosion
- All hazardous wastes shall be securely stored, under a shed for eventual transportation and disposal to the authorized contractor by NEMA
- The solid domestic waste shall be segregated and stored within the premises temporarily and then sent to CGK waste management facility

6.3.2.2 Air Impact Mitigation Measures

- Checking of vehicles and construction machinery to ensure compliance to emissions regulations
- Transportation vehicles, generators and machineries to be properly and timely maintained
- and serviced regularly to control the emission of air pollutants in order to maintain the emissions of NO_X and SO_X within the limits established by NEMA
- Storage facilities shall be equipped with leak detection systems

- Minimize idling time for vehicles and adequate parking provision and proper traffic arrangement for smooth traffic flow
- Attenuation of pollution/ protection of receptor through strengthening of existing greenbelt/ green cover

6.3.2.3 Noise Impact Mitigation Measures

- Provision of proper parking arrangement, traffic management plan for smooth flow of vehicles help to abate noise pollution due to vehicular traffic. Green belts and landscaping
- shall act as noise buffer.

6.3.2.4 Water Impact Mitigation Measures

- waste water shall be recycled /reused for flushing, gardening and cooling tower makeup
- Rain water harvesting shall be promoted. Rainwater from the landscape area and landscape area will be used to recharge the ground water sources through recharge pit
- Provision of Storm water drainage system with adequate capacity, Proper maintenance of storm water drainage.
- Installation of water harvesting facilities

6.3.2.5 Socio-Economic Environment Impacts Mitigation Measures

- Both skilled and unskilled local person shall be given preference for the jobs in the operation and maintenance of the plant.

6.4. Impact Matrix

The matrix was designed for the assessment of impacts associated with almost any type of project. Its method of a checklist that incorporates qualitative information on cause-and-effect relationships but it is also useful for communicating results.

Matrix method incorporates a list of impacting activities and their likely environmental impacts, presented in a matrix format. Combining these lists as horizontal and vertical axes in the matrix allows the identification of cause effect relationships, if any, between specific activities and impacts. The impact matrix for the actions identified in Table 4.1 along with various environmental parameters. A rating scale has been devised to give severity of impacts in the following manner.

A. Beneficial (positive) impact – Long term

B. Low beneficial impact – Short term
C. Strong adverse (negative) impact – Long term
D. Low adverse impact (localized in nature) – Short term
E. No impacts on environment

Table 6.1 Impact Matrix

S.N.	Activity	Positive impact		Negative Impact		No Impact
		Short Term	Long Term	Short Term	Long Term	
Pre-Project Activity						
1	Displacement and resettlement of local people					X
2	Change in Land use					X
3	Loss of trees/ vegetation		X			
4	Shifting of equipment, machinery and materials					X
5	Employment for local people		X			
Construction Phase						
1	Pressure on infrastructure and transportation system			X		
2	Impact on air quality including dust generation			X		
3	Noise Pollution			X		
4	Traffic					X
5	Impact on the land/soil environment			X		
6	Impact on groundwater					X
7	Stacking and disposal of construction material			X		
8	Impact on water quality			X		
9	Health and safety conditions of people			X		
10	Social impact	X				
11	Economic impact	X				
Operation Phase						

1	Increase in air pollution and noise levels				X	
2	Water harvesting and recharge		X			
3	Disposal of solid waste				X	
4	Infrastructure development		X			
5	Quality of life		X			
6	Handling operations for transfer, charging of raw materials, final product				X	

Table 6.2 Summary of Environmental Impacts and Mitigation Measures

Impacting Activity		Potential Impact		Mitigation Measures	Compliance/Regulation/ International Best Practice/standards
Environment/Social attribute	**Source Contaminants**	**Environment**	**Health & Safety**		
CONSTRUCTION PHASE					
Total Workers: 20 8 -Direct 12 -Indirect	Generation of sewage, organic wastes, construction debris, etc	Possible contamination of project site and nearby water bodies	Potential risk of respiratory irritation, discomfort, or illness to workers	-Local workers will be employed as much as possible -Proper sanitation facilities will be provided -No temporary shelters because local workers will be engaged	----------
Air Emissions	Dust and air emissions particularly due to excavation, construction, and movement of vehicles resulting in air pollution	Rise in RSPM levels at project site	Potential risk of respiratory irritation, discomfort, or illness to workers	-Barricading sheets shall be provided -Provision of spraying water to reduce dust emission -Excavated top soil to be preserved and reused in landscaping -Ensuring all vehicles, machines, generators, compressors are well maintained and regularly serviced	EMCA - Air Quality Regulations 2014
Noise Generation	Construction noise mainly due	Rise in decibel level of	Undesired noise can	-The vehicles used will be fitted with proper	- The Environmental

	to moving vehicles, operations of machines, cranes etc	ambient noise	cause discomfort to the body, Excessive noise pollution in construction site can negatively affect psychological health e.g. occurrence of aggressive behavior, disturbance of sleep, constant stress, fatigue and hypertension. Hampered sleeping patterns, and may lead to irritation and uncomfortable situations	acoustic gadgets -Wherever this cannot be achieved the area will be earmarked as a high noise level area requiring use of ear protection gadgets	Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009
Soil and Ground water Contamination	-Spillage of concrete mixtures containing additives and plasticizers			- All fuel, Liquid Cargo storage will be sited on an impervious base within a bund and secure place. The base and bund walls will be impermeable to	- The Environmental Management and Coordination (Water Quality) Regulations, 2006

	- Spillage of construction materials containing heavy metals, paints, coatings, liners etc			the material stored and of an adequate capacity. Storage at or above roof level will be avoided. - Leaking or empty drums will be handled as per environment management plan -Special care will be taken during delivery of construction materials especially when fuels and hazardous materials are being handled -Ensure that workers know what to do in the event of a spillage.	
OPERATION PHASE					
Air Emissions	-Release of VOCs during operational activities (filling, withdrawal, loading/unloading, tank cleaning and degassing) -For storage tanks, the total emission of VOC is the result of two types of losses: Breathing/Standing losses and withdrawal losses	- Contamination of surface and sub-surface water bodies during operational activities. (Soil and ground water) -The greater the variations in temperature of the fuel, the	-Potential risk of respiratory irritation, discomfort or illness to workers -Potential risk of dermal contact and inhalation -	-Above storage Tanks ASTs i.e. mounded bullets shall have a secondary containment area that will contain leakages and allow leaks to be easily detected. - Secondary containment for ASTs must be impermeable to the materials being stored. Methods include berms, dikes, liners, vaults, and double-walled tanks -A manually controlled	- Fossil Fuel Emission Control Regulations 2006 - EMCA - Air Quality Regulations 2014 -US Environment Protection Agency Industry Emission Factor OISD-STD-112 Safe Handling of Air Hydrocarbon Mixtures and pyrophoric substances

		greater the potential loss and the larger the risk of contamination due to condensation.		sump pump shall be used to collect rain water that may accumulate in the containment area of storage tanks. Any discharge shall be inspected for petroleum or chemicals prior to being dispensed - Installation of vapor recovery systems to collect the VOC's emitted during transfer operations process. Equipment for transferring product out of and into storage will consist of aboveground piping, hoses/loading arms, valves, instrumentation and alarms - Efficiencies of primary seals may be improved through the use of weather seals. Additional controls may be added through a secondary seal. - Evaporative losses from the floating roof design are limited to losses from the seal system and roof fittings (standing storage loss) and any exposed liquid on the tank walls (withdrawal loss). - Using a pressure-	-

				ventilated cap can reduce evaporation losses a further 50% Direct venting of the tank fumes is restricted until a slight pressure has built up in the tank. -Having a painted and pressure vented tank has a 75% vaporation loss reduction compared to a dark tank. - Placing a painted and pressure vented tank in the shade will further reduce the evaporation losses by over 40%. The roof also helps reduce weathering of hoses and valves. - Accumulated water in tanks shall be regularly drained off and separated from the oil which is recoverable, while the water is sent for treatment.	
Waste Water	-Domestic Sewage	-Potential risk of contamination to water bodies from waste water runoff	-Potential risk of dermal contact and inhalation from spill sandleaks	- Septic Tanks will be provided and the treated water will be used for horticulture	-Water Quality Regulations
Hazardous Materials,	-Risk of fire and explosions due to	-Potential risk of loss of life		- Storage equipment shall meet standards for structural design and	- OISD-STD 144- Fire protection facilities for

Fire and Explosion	the flammable and combustible nature of petroleum products -Risk of leaks and accidental releases from equipment, tanks, pipes etc during loading and unloading. (handling)	or injury due to fire		integrity. American Petroleum Institute (API) standards are the primary industry standards by which most above ground welded storage tanks are designed, constructed and maintained. These standards address both newly constructed and existing aboveground storage tanks used in the petroleum, petrochemical and chemical industries. The standards prescribe leak detection, leak prevention, and leak containment with emphasis on leak or spill detection and containment	LPG bottling plant
Hazardous Waste	-Contaminated equipment and protective clothing -Pigging waste	-Risk of site contamination from hazardous waste and risk of contamination to water bodies.		- Conduct a Hazard Risk Assessment using internationally accepted methodologies such as Hazardous Operations Analysis(HAZOP), Failure Mode and Effects Analysis (FMEA) and Hazard Identification (HAZID). The management actions shall be included in a Hazardous Material Management Plan - Shutdown valves shall be installed to allow	-Waste Management regulations 2006 - OISD-STD-114 – Safe Handling of Hazardous Chemicals

				early shutdown or isolation in the event of a spill; develop automatic shutdown actions through an emergency shutdown system for significant spill scenarios so that the facility may be rapidly brought into a safe condition. - Ensure adequate personnel training in oil & Gas spill (LPG Leakage) prevention, containment and response	

Table 6.3 Environmental Impact Matrix table

IMPACT / AREA	NO EFFECT	+VE EFFECT	-VE EFFECT	BENEF-ICIAL	ADVERSE	PROBLE-MATIC	SHORT TERM	LONG TERM	REVER-SIBLE	IRREV-ERSIBLE
Soil characteristics	X									
Natural Drainage	X									
Regional Plans Conformity	X									
Air Quality			X				X		X	
Ground water	X									
Surface water	X									
Noise			X				X		X	
Wildlife	X									
Endangered species	X									
Natural Vegetation		X						X		
Exotic Vegetation		X						X		
Demography	X									
Recreation	X									
Health & Safety		X		X				X		

Regional economy		**X**						**X**		
National economy		**X**						**X**		
Public Facilities				**X**						
Public Services		**X**						**X**		
Transportation			**X**							

6.6 Conclusion

From the above discussion it can be concluded that proposed project activity shall not create any significant negative impact on physical features, water, noise and air environment. The proposed project shall generate additional indirect employment and indirect service sector enhancement in the region and would help in the socio-economic up-liftmen of the local area as well as the county.

7.0 ENVIRONMENT MANAGEMENT AND MONITORING PLAN

7.1. Introduction

The Environmental Management Plan (EMP) provides an essential link between predicted impacts and mitigation measures during implementation and operational activities. EMP outlines the mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or mitigate adverse environmental impacts, and the actions needed to implement these measures.
The likely impacts on various components of environment due to the project during developmental activities have been identified and measures for their mitigation are suggested.
The EMP lists all the requirements to ensure effective mitigation of every potential biophysical and socio-economic impact identified in the EIA. For each attribute, or operation, which could otherwise give rise to impact, the following information is presented:

- A comprehensive listing of the mitigation measures
- Parameters that will be monitored to ensure effective implementation of the action
- Timing for implementation of the action to ensure that the objectives of mitigation are fully met

The EMP comprises a series of components covering direct mitigation and environmental monitoring, an outline waste management plan and a project site restoration plan. Therefore, environmental management plan has been prepared for each of the above developmental activities.

7.2. EMP during Construction Phase

Environmental pollution during construction stage will be limited and for a temporary period during the construction activity. Construction shall be planned in such a way that excavated material shall be disposed safely. The manpower required for these activities shall preferably be employed from nearby villages so that avenues of employment will be open to local people.

7.2.1 Air Environment

During the construction phase, gaseous emissions are expected from the heavy machineries deployed for construction. All other emission sources are intermittent. Though the gaseous emissions are not expected to contribute significantly to the ambient air quality, some generic measures to reduce fugitive and gaseous pollutants emissions during construction phase from point area and line sources shall include the following:

- All equipment used during construction shall be well maintained.
- The storage and handling of soil, sub-soils, top-soils and materials will be carefully managed to minimize the risk of windblown material and dust
- To avoid generation of air borne dust, water sprinkling shall be done.
- There will be no on-site burning of any waste arising from any construction activities

- All vehicles delivering construction materials or removing soil will be covered to prevent escape of dust
- Engines and exhaust systems of all vehicle and equipment will be maintained so that exhaust emissions do not exceed statutory limits and that all vehicles and equipment are maintained in accordance with manufactures' manuals. Periodic monitoring of this shall be undertaken to ensure compliance
- Exhausts of other equipment used for construction (e.g. generators) will be positioned at a sufficient height to ensure dispersal of exhaust emissions and meet the standards set by Fossil fuel emission legislation and NEMA.

7.2.2 Noise Environment

The following environmental management measures are recommended to mitigate adverse impacts on noise environment during construction phase:

- Earth movers and construction machinery with low noise levels shall be used
- Periodic maintenance of construction machinery and transportation vehicles shall be undertaken
- Onsite workers shall be provided with noise protection devices such as ear plugs/ muffs wherever necessary
- Periodic monitoring for the noise levels within the project site shall be undertaken to ensure compliance per NEMA set standards

7.2.3 Water Environment

Drinking water requirements during the construction phase by the contractors shall be met from borewells on site. Construction labourers shall be provided with adequate quantity of drinking water of potable quality.

Directly or indirectly all the environmental components get affected due to the construction activity. The following environmental protection and enhancement measures are suggested for implementation by the contractor or the authority during the construction as applicable.

Sufficient and appropriate sanitary facilities shall be provided in order to maintain hygienic conditions in the camps of construction labourers. The wastes, such as, sanitary wastes shall be treated in septic tanks followed by soak pits of appropriate size and technology.

The solid waste generated shall be collected and disposed in an appropriate manner either at a landfill site or used as compost to be used in lawns/gardening purpose.

7.2.4 Land Environment

- On completion of construction works all temporary structures, surplus materials and wastes shall be completely removed. Dumping of construction waste on agricultural land will be prohibited and used appropriately.
- The solid wastes such as paints, lubricants, oil or any other non-biodegradable wastes that have leachable constituents will be disposed to authorized recyclers.
- A waste management plan shall be prepared or integrated with existing plan before the commissioning, implemented and monitored. In areas, where soil quality for natural vegetation is of critical concern, loosening of

soil in such areas will be done to mitigate soil compaction caused due to operation of heavy machinery.

7.2.5 Biological Environment

The region does not have dense vegetation and landuse is dominated by agriculture activities. Following environmental management measures are recommended to mitigate adverse impacts on biological environment during construction phase:

- Plantation will be commenced at the time when site clearing will be undertaken.
- Number of trees will be replanted against the trees removed from site.
- Native species will be preferred for plantation in addition to beautification plants/species.

7.2.6 Socio-economic Environment

Given that the project and related developments like construction camps will not be dependent on local resources (power, water), during both construction and operations, the only likely impact on infrastructure would be on the roads, during the construction phase. Considering the high traffic emanating during construction phase an effective traffic management scheme will be put in place to avoid congestion on the nearby and local roads. Local persons will get employment during Construction phase.

7.2.7 Health and Safety

- The movement of heavy equipment will be undertaken with proper precaution to prevent any accidents on the road. Occupational risk shall be minimized at the project site through implementation of a full proof safety system. Speed limit set for movement of vehicles with 20 km/hr on village roads to reduce risks of accidents or injuries.
- Safety training shall be provided to all construction workers on operation of equipment. Security shall also be extended during non-working hours to ensure there is controlled access to the machinery and equipment.
- The contractors shall also be vigilant to detect workers showing symptoms of communicable diseases. Health check up of the contract labors shall be done/ recorded at times. All illness and incidents shall be reported and recorded.

7.3 EMP during Operation Phase

In order to mitigate the impacts due to capacity expansion of facility on various environmental components, the following environmental management measures are recommended:

7.3.1 Air Environment

- Leak detection and repair (LDAR) program shall be implemented in the facility
- Ambient air quality with respect to SPM, RPM, SO_2, NOx, H_2S, CO and HC monitoring shall be continued in the impact zone as per regulations
- To minimize occupational exposure/hazards, the present practice of using personal protective equipment e.g. helmets, safety (gas) mask/safety dress, safety harness for working at heights, safety shoes, safety goggles, low temperature hand gloves & shock resistant hand gloves etc. be ensured for workers engaged in operation of process units within the facility complex
- Stacks of adequate height (NEMA norms) for diesel generator Sets to ensure adequate dispersal of pollutants will be provided.
- Waste Lube oil will not be incinerated and will be sold to NEMA authorised waste oil recyclers
- All access roads (internal as well as external) to be used by the project authorities will be paved (either with Murom, concrete or bitumen) to suppress the dust generation along the roads

7.3.2 Noise Environment

Similar measures as proposed in the construction phase for noise making machinery, to ensure practicably low noise levels within the work environment.

The major areas of concern for noise generation will be adequately addressed by considering it during procurement of the machinery from vendors, project implementation stage. Further feedback from the monitored noise levels at sensitive locations will be taken to ensure that the impact due to high noise levels is practically minimized

- Monitoring job and location specific noise levels for compliance with HSE regulations by verifying acceptability of noise levels caused by the project activities and comparison with noise criteria
- Conducting periodic audiometric tests for employees working close to high noise levels, such as compressors, diesel generator sets, etc
- Provision of PPE's will be done and their proper usage will be ensured for eardrum protection of the workers as well as visitors
- Acoustic barriers and silencers shall be used in equipment wherever necessary
- Sound proofing/ glass panelling shall be provided at critical operating stations/ control rooms, etc
- Monitoring of ambient noise levels shall also be carried out regularly both inside the facility area as well as outside the peripheral greenbelt.

7.3.3 Water Environment

- For domestic sewage, septic tank shall be provided.

- There will be no industrial effluent generated in this plant. However, waste water generated during plant operations (during washing of empty cylinders) shall be recirculated/ resued.
- There shall no increase in quantity of waste water generation from operation of proposed Mounded Bullets. The existing sources of waste water generation

- **Rain Water Harvesting:** The rain water harvesting program shall be implemented in LPG bottling plant. The system has been developed around the storage tanks, admn. Building in the plant. The practice shall be continued and extended further with the proposed gas storage facilities.

7.3.4 Land Environment

- Every precaution shall be taken to avoid spillage of oils on soils to protect groundwater and to avoid any danger to other soil microbial groups which are sensitive to oil pollution
- Greenbelt in and around the facility will be strengthened/maintained
- A record w.r.t quantity, quality and treatment/management of solid/hazardous waste shall be maintained at environmental monitoring cell

Solid/Hazardous Waste Management

- No solid waste will be generated in the operation of LPG bottling plan

7.3.5 Biological Environment

Development of green belt with carefully selected plant species is of prime importance due to their capacity to reduce noise and air pollution impacts by attenuation/assimilation and for providing food and habitat for local micro fauna.

7.3.6 Socio-economic Environment

In order to mitigate the impacts likely to arise out of the proposed project and also to maintain good will of local people, steps will be taken for improving the social environment. Necessary social welfare measures by the industry shall be undertaken in gaining public confidence and to meet local area development requirement. The following measures are suggested:

- DAIMA GAS shall continue to undertake social welfare programs for the betterment of the Quality of Life of villages around in collaboration with the local bodies
- Some basic amenities, viz. education, safe drinking water supply to the nearby villages may be taken up
- Regular medical check up shall be continued at times in the area around the facility
- Focus shall be on to educate locals regarding safety measure provided in the plant.

7.4 Environmental Monitoring Programme

IntroductionEnvironmental Management is nothing but resource management and environmental planning is just the same as development planning. They are just the other side of the same coin. The resource management and development planning

look at the issue from narrow micro-economical point of view while environmental management views the issue from the broader prospective of long term sustained development option, which ensures that the environment is not desecrated.
For the effective and consistent functioning of the project, proper environmental monitoring programme shall be carried at the LPG Bottling Plant.
The programme shall include the following:

- Environmental Monitoring
- Personnel Training
- Regular Environmental audits and Correction measures
- Documentation–standards operation procedures Environmental Management Plan and other records

Environmental Monitoring

Work of monitoring shall be carried out at the locations to assess the environmental health in the post period. A post study monitoring programme is important as it provides useful information on the following aspects.

- It helps to verify the predictions on environmental impacts presented in this study.
- It helps to indicate warnings of the development of any alarming environmental situations, and thus, provides opportunities for adopting appropriate control measures in advance.

The monitoring programmes in different areas of environment, outlined in the next few sections, have been based on the findings of the impact assessment studies described in Chapter 4. Post study monitoring programme have been summed up in **Table 7.1.**

Table 7.1: Post Study Environmental Monitoring Program

Area of Monitoring	Sampling Locations	Frequency of Sampling	Parameters To be Analysed
Ambient Air Quality	Station within Premises	Once in six months	PM_{10},$PM_{2.5}$,SO_2,NO_x,Hc, VOCs and other parameters as specified by NEMA
	Stack monitoring of diesel generators	Once in three months	PM_{10}, $PM_{2.5}$,SO_2, NO_x, CO and other parameters as specified by NEMA
Water	Ground Water sample within the plant	Twice in a year	- Physical and Chemical parameters - Bacteriological parameters - Heavy metals and toxic constituents
Noise	Within Plant shed for bottling operations	Twice a year	Sound Pressure Levels (Leq) during Plant operations.
Solid Waste	Records of generation of used drums, bags	As and when required	----------

	and records of their dispatch to supplies for refilling		
Environmental Audit	As per EMCA EIA/EA regulations	**Once a year**	----------

7.4.1 Ambient Air Quality

Monitoring of ambient air quality at the LPG Bottling Plant site shall be carried out on a regular basis to ascertain the levels of hydrocarbons in the atmosphere; ambient air quality shall be monitored as per Table above

7.4.2 Surface Water Quality

Water quality constitutes another important area in the post study monitoring programme. There are no major streams or perennial sources of surface water in the study area. Contamination of surface water in the vicinity of LPG Bottling Plant area during the operation is possible only in one form.

i. Contamination of rain water passing through the LPG Bottling Plant.

Surface water near the LPG Bottling Plant area shall be generally sampled as per the above table.

7.4.3 Noise Level

Ambient noise levels will also be monitored within and around the plant.

7.5 Environmental Management Cell

The Location-in-charge of the LPG Bottling Plant with the assistance of operation and maintenance engineers at respective stations presently look after environmental management. Technical officers of the LPG Bottling Plant station shall regularly carry out the following:

- Sampling and analysis of noise and water samples.
- Systematic and routine housekeeping at the LPG Bottling Plant

Apart from the regulatory requirements, officials conduct inter station environment auditing to improve the performance.

- Reviewing the whole operation of LPG Bottling Plant, once in every two years, to identify the environmental aspects.
- Following the changes/amendments to legislation pertaining to environment management.
- Assessing the level of experience, competence and training to ensure the capability of personnel, especially those carrying out specialized environmental management functions.
- Conducting environmental awareness programme for the employees at LPG Bottling Plant site.
- Measurement of pollution emissions and levels at LPG Bottling Plant through an external agency

7.6 ENVIRONMENT MANAGEMENT PLAN CONSTRUCTION & OPERATION

Table 7.2 Environment Management Plan

Environmental Attribute/Receptor	Mitigation Measures	Timeframe	Responsibility	Cost in Kshs
Construction Phase				
Air Emissions	-Checking of vehicles and construction machinery to ensure compliance to legal standards as prescribed in the traffic act -Transportation vehicles, diesel generator sets and machineries to be properly and timely maintained and serviced regularly to control the emission of air pollutants in order to maintain the emissions of NO_X and SO_X within the limits established by NEMA -Minimize idling time for vehicles and adequate parking provision and proper traffic arrangement for smooth traffic flow -Use of good quality fuel and lubricants will be promoted. Moreover, low sulphur content diesel shall be used as fuel for diesel generator sets to control emission of SO_2 -Water sprinkling shall be carried out to suppress fugitive dust during earthworks and along unpaved sections of access roads -Attenuation of pollution/ protection of receptor through strengthening of existing greenbelt/ green cover	Entire Construction Phase	Contractor & Project Manager	120,000 p.a
Noise	-Acoustic enclosures for diesel generator sets will be provided -Pumps – Enclosure in acoustic screen, allowing for engine cooling and exhaust, use of anti-vibration mounting, flexible couplings of hoses, maintaining adequate inlet pressure -Provision of Intake mufflers, unidirectional fan for Cooling and enclosures for electrical motors -Provision of ear plugs for labour in high noise area -Provision of barricades along the periphery of the site	Construction period	Project Manager & Contractor	200,000 p.a

	-All contractors and subcontractors involved in the construction phase shall comply with acceptable noise standards -Activities that take place near sensitive receptors to be carefully planned (restricted to daytime, taking into account weather conditions etc.) -Vehicles and generator sets to be serviced regularly and maintained properly to avoid any unwanted generation of noise or vibration from them -Use of suitable muffler systems/ enclosures/ sound proof glass paneling on heavy equipment/ pumps/ blowers -Pumps and blowers may be mounted on rubber pads or any other noise absorbing materials -In case of steady noise levels above 85 dB (A), initiation of hearing conservation measures -Strengthening of greenbelt for noise attenuation may be taken up, etc.			
Water	-Water Avoidance of wastage of curing water -Use of tanker water for construction activity. -Provision of temporary toilets for labour -Wastewater generated will be recycled/reused during operation of the LPG Plant	Construction and operation period	Contractor and project manager	120,000 p.a
Land/Soil	-Top soil will be stored carefully and will be used again after construction/installation phase is over so as to restore the fertility of project site -Bituminous materials / other chemicals, if any, shall not be allowed to leach into the soil -Methods to reuse earth material generated during excavation will be followed	Construction Period	Contractor/project Manager	200,000 one-off

	-Waste oil generated from diesel Generator sets will be handed over to authorized recyclers approved by NEMA -Usage of appropriate monitoring and control facilities for construction equipments deployed -All hazardous wastes shall be securely stored, under a shed for eventual transportation and disposal to the authorized dealers -The solid waste generation due to workers working at site will be segregated and will be transported and disposed of to CGK waste disposal facility -Chemicals/Paints etc. used during construction phase will be stored safely			
Biological	-Care will be taken to avoid destroying any biodiversity where possible	Construction & Operation periods	Proponent/contractor/project manager	50,000 every two years
Socio-economic	-Employing local people for construction work to the maximum extent possible. -Providing proper facilities for domestic supply, sanitation, domestic fuel, education, transportation etc. for the construction workers. -Sensitization and awareness creation about HIV and AIDS -Barricades, fences and necessary personnel protective equipment such as safety helmet, shoes, goggles, gloves, harness etc. will be provided to the workers and employees.	Entire Project cycle	Project manager/contractor /proponent	60,000 p.a
Health & Safety	-The workers will be diagnosed for respiratory functions at periodic intervals and during specific complaints etc. Medical Aid as per Factory Act and Panel doctor facility will be provided to the workers. -The health of workers will be checked for general illness; first time upon employment and thereafter at periodic intervals, as per the local laws and	Construction phase	Proponent/Project Manager/ Contractor	200,000 p.a

	regulations. -Insignificant impact is expected on the workers health and safety during the operation phase stage. -Job rotation schemes will be practiced for over-exposed persons. -Constructional and occupational safety measures to be adopted during construction phase of the industry.			
Operation Phase				
Air Emissions	-Checking of vehicles and construction machinery to ensure compliance to emissions regulations -Transportation vehicles, generators and machineries to be properly and timely maintained -and serviced regularly to control the emission of air pollutants in order to maintain the emissions of NO_X and SO_X within the limits established by NEMA -Storage facilities shall be equipped with leak detection systems -Minimize idling time for vehicles and adequate parking provision and proper traffic arrangement for smooth traffic flow -Attenuation of pollution/ protection of receptor through strengthening of existing greenbelt/ green cover	Every three months	Proponent/facility Manager	10,000 p.m
Noise	-Provision of proper parking arrangement, traffic management plan for smooth flow of vehicles help to abate noise pollution due to vehicular traffic. Green belts and landscaping shall act as noise buffer.	daily	Facility manager	5,000 p.m
Water	-waste water shall be recycled /reused for flushing, gardening and cooling tower makeup -Rain water harvesting shall be promoted. Rainwater from the landscape area and landscape area will be used to recharge the ground water sources through recharge pit -Provision of Storm water drainage system with adequate capacity, Proper			200,000 one-off

	maintenance of storm water drainage. -Installation of water harvesting facilities			
Land/Soil	-Installation of drainage ditches at project site to prevent erosion -All hazardous wastes shall be securely stored, under a shed for eventual transportation and disposal to the authorized contractor by NEMA -The solid domestic waste shall be segregated and stored within the premises temporarily and then sent to CGK waste management facility	Project lifetime	Facility manager	5000 p.m
Biological	-replace lost vegetation with indigenous species	Construction and operation phases	Project manager/facility manager	50,000 one-off cost
Socio-economic	- Both skilled and unskilled local person shall be given preference for the jobs in the operation and maintenance of the plant. -Sensitization and awareness about HIV and AIDS			3,000 p.m
Health & Safety	-Installation and proper maintenance of Fire Engine -regular training and refresher curses on occupational safety - occupational safety measures to be adopted during operation phase of the industry. -Regular fire drills	Monthly drills One-off engine installation	Proponent/facility Manager	800,000

7.7 Environmental Management Plan- Gas Filling Facility Operation Phase

Table 7.3 LPG Gas Filling operation Environmental Management and Monitoring Plan

ACTIVITY/ISSUES	MITIGATION/ACTION/ACTION	PERSON RESPONSIBLE	TIMEFRAME
General	• A maintenance plan for the filling station must be developed to ensuring that good working order is achieved	Developer/Operator	One-off
Health & Safety	• An emergency plan (including fire management) must be developed and implemented; the relevant authority must approve this plan. Ensure that all fire extinguishers are replaced on or before their expiry dates. • Site Safety checks should be carried out in accordance with the pertinent Occupational Health and Safety requirements prior to site closure. • Telephone numbers of emergency services shall be posted conspicuously in the office for use in emergency situations	Developer/filling station operator Developer/filling station operator Developer/filling station operator	Continous Continous Continous
Air Pollution	• All forms of dust/air pollution must be managed as per regulations this includes the control of noxious and offensive gases, smoke, dust and vehicular emissions. Under no circumstances may heavy smoke be released into the air.	Developer/filling station operator	Continous
Light Pollution	• Security lights are to be angled downwards to avoid disturbance to adjoining landowners. Illumination of the buildings must take into account the possible distraction glare might have on motorists	Developer	Continous
Storm Water Management	• The storm water system, especially the discharge points, must be inspected and damaged areas must be repaired if required. • No waste or refuse must be allowed to access the storm	Developer Developer	Continous Continous

	water infrastructure • Discharge points must be inspected for blockages of any kind; these must be removed timeously to ensure the efficient operation of the storm water management system.	Developer	Continous
Fire Prevention & Control	• The Filling station operator shall take all reasonable and precautionary steps to ensure that uncontrolled fires are not started as a consequence of his activities on site. • The Filling station operator shall ensure that there is basic fire- fighting equipment available on site as per requirement of the local Emergency Services • The Filling station operator shall ensure that all site personnel are aware of the fire risks and how to deal with any fires that occur. This shall include, but not be limited to: • Regular fire prevention talks • Posting of regular reminders to staff. • Regular Fire-fighting training • Any accidental fires, which occur, shall be reported to the relevant authorities immediately	Developer/filling station operator	Continous
Emergency Procedure	• The Filling station operator shall submit Method Statements covering procedures and response plan for the main activities, which could generate emergency situations through accidents or neglect of responsibilities. These situations include, but are not limited to: • Accidental fires • Accidental leaks and spillages • Vehicle and plant accidents • Blasting (if required) • The Filling station operator shall assemble and clearly list the relevant emergency telephone contact numbers for staff and brief staff on the required procedures.	Developer/filling station operator Developer/filling station operator	As Necessary Weekly

Accidental Leaks & Spills	• The Filling station operator shall ensure that his employees are aware of the procedure for dealing with spills and leaks. • The Filling station operator shall also ensure that the necessary materials and equipment for dealing with the spills and leaks is available on site at all times.	Developer/filling station operator	Continous
Hydrocarbon Spills	• The source of the spill shall be isolated and the spillage contained using sand berms, sandbags, sawdust, absorbent material and/or other approved materials. • The area shall be cordoned off and secured. • The Filling station operator shall ensure that there is always a supply of absorbent material readily available to absorb/breakdown the spill. • The Filling station operator shall notify the relevant authorities of any spills that occur.	Developer/filling station operator	As Necessary
Hazardous Substances	• If potentially hazardous substances are to be stored on site, the Filing station operator shall provide a Method Statement detailing the substances/materials to be used together with the procedures for the storage, handling and disposal of the materials in a manner which will reduce the risk of pollution that may occur from day to day storage, handling, use and/or from accidental release of any hazardous substances used. • Hazardous chemical substances used shall be stored in secondary containers. • The relevant Material Safety Data Sheets (MSDS) shall be available on Site. Procedures detailed in the MSDS shall be followed in the event of an emergency situation.	Developer/filling station operator	Monitor Daily-Weekly
	• The Filling station operator must ensure that all hazardous chemical substances are labelled, packed, transported and stored in order to avoid the spread of contamination. • All hazardous chemical substance waste must be disposed of in	Developer/filling station operator	Monitor Daily-Weekly

	accordance with the Hazardous Chemical Substances Regulations. • The waste, resulting from the use of hazardous materials, shall be disposed of at a hazardous waste disposal site as approved by NEMA. Storage and disposal of waste is regulated through other legislation, which should be complied with i.e. the Occupational Health and Safety Act.		

8.0 FIRE PROTECTION

General Fire protection provisions shall be based on a safety analysis of local conditions, exposure from or to other sites, availability of a water supply, and effectiveness of fire brigades and fire departments. The analysis shall include possible but realistic accident scenarios that may occur, including scenarios of vapor release, ignition, and fire.

8.1 Access for Fire-fighting

The layout of the storage facility, including the arrangement and location of plant roads, walkways, doors. and operating equipment, shall be designed to permit personnel and equipment to reach any area affected by fire rapidly and effectively. The layout shall permit access from at least two directions. Emergency escape as well as access for firefighting shall be considered.

8.2 Fire Water Use

Storage facilities for LPG shall be provided with a fire water system unless a safety analysis shows this protection to be unnecessary or impractical.

8.3 System Design

The design of the fire water system shall be in accordance with the following:

- A looped fire water system shall be provided around the storage and handling portions of an LPG facility.
- Sufficient isolation valves shall be provided in the fire water grid to prevent loss of the grid due to a single break in the water main. Block valves shall be arranged so that all parts of the plant can be protected by a portion of the fire water main system when an impaired section is isolated for repair.
- The capacity of the fire water system shall be equal to the amount of fire water required to cool the largest vessel being protected (or if multiple vessels are on a commonly activated fixed deluge or spray system, the capacity of the system), plus the amount required to cool adjacent vessels, plus reserve capacity for up to three additional 250-gallon-per-minute cooling streams. Where the capacity of the fire water system is determined by the requirement for LPG storage, the system is permitted to be sectionalized to reduce the maximum simultaneous requirement for fire water.
- Pipe used for fire water mains and branch lines to hydrants shall be at least 6 NPS in size. Branch lines to deluge, monitor, or spray systems are permitted to be smaller, provided hydraulic calculations show that the size selected will supply the design demand at the required pressure.
- The fire water system shall be functional in all seasons and shall be capable of delivering 100% of the design rate for at least 4 hours. The fire water system shall be suitably protected from freezing where necessary.
- The fire water grid shall be designed so that at least half the water required by the single largest incident can be delivered if any single section of the fire water main is lost.
- Regardless of the fire water application method used, the location of hydrants shall be arranged so that each storage vessel can be reached from at least

two directions by at least three cooling streams none of which uses more than 300 ft of hose.

- The fire water system shall be designed to provide water for cooling to the protected equipment within 60 seconds of activation to achieve design water delivery rates within 10 minutes of system activation.
- The fire water system shall be designed to facilitate testing to assure reliability, adequate flow rate, and adequate coverage of the protected equipment.
- The fire water systems shall be tested to verify that their performance is as designed. Since the capacity of the water grid can deteriorate gradually as a result of scale buildup in the water mains, a Hazen-Williams coefficient no greater than 100 shall be used for unlined steel pipe.

8.4 Fire Water Application Methods

LPG storage vessels shall be protected by water deluge systems, fixed monitors, water spray systems, or any combination of these systems. Portable equipment may be used but shall not be a primary method of water application.

8.4.1 Water Deluge System

A water deluge system is a system in which all the water is applied at the top of the vessel and allowed to run down the sides. When a water deluge system is selected for the protection of LPG storage facilities, it shall include the design features described below.

- The system shall be designed so that under nonfire conditions, the water flows evenly over the entire surface of the vessel. The adequacy of the water coverage shall be determined by means of performance tests.
- If weirs are used to improve distribution, they shall be provided with drainage to prevent standing water, which may increase corrosion.
- Pipe used for main water distribution lines shall have a diameter of at least 3 in.
- Top-mounted water distribution nozzles shall be at least 11;2 in. in size and shall be provided with suitable deflectors or weirs to achieve good water distribution.
- The system shall be manually operated from a safe location that is outside the spill containment area and that is at least 50 ft from the vessel being protected. The location of the actuating valve shall be clearly and prominently marked. In locations with unattended or partially attended operations, consideration shall be given to additional methods of system activation such as automatic or remote operation. When the system is remotely or automatically operated, a full-size manually operated bypass valve shall also be provided in an accessible, safe location.

8.4.2 Fixed Monitors

Fire water monitors permanently connected to the fire water grid can be used to apply cooling water to the shell of LPG storage vessels. Where protection by means of monitors is selected, the system shall include the design features described below:

- The entire surface of each vessel shall be reached with streams from the monitors.
- Each monitor shall be accessible during a fire or shall be remotely activated and controlled.
- Monitor nozzles shall be adjustable for fog or straight stream, as required, to provide the most effective coverage of the protected vessel.
- In freezing climates, monitors shall be suitably protected against freezing.

8.4.3 Water Spray Systems

A water spray system uses many spray nozzles arranged in a grid pattern to distribute the water evenly over the LPG vessel. When a water spray system is selected for the protection of LPG storage facilities, it shall include the design features described below:

- The system shall be designed so that the water is applied evenly over the entire surface of the vessel that may be exposed to fire. Allowance for rundown is permitted. The adequacy of the water coverage shall be determined by performance tests.
- The spray system shall be an open-head system, with all nozzles supplied from the top of the supply branch line and each branch line shall be from the top of the water distribution main line. Spray orifice size shall be at least 0.25 n. Larger orifice sizes will reduce the tendency of the nozzles to become clogged.
- The system shall be manually operated from a safe location that is outside the spill containment area and that is at least 50 ft from the vessel being protected. The location of the actuating valve shall be clearly and prominently marked. In locations with unattended or partially attended operations, consideration shall be given to additional methods of system activation such as automatic or remote operation. When the system is remotely or automatically operated, a full-size manually operated bypass valve shall also be provided in an accessible, safe location.
- Flush-out connections shall be installed in the system to permit flushing at periodic intervals. Accessible low-point drain connections shall also be provided.
- The sizing of all piping shall be based on hydraulic calculations. Pipe used for main water distribution lines shall have a diameter of at least 3 in. Pipe used for branch lines to spray heads is pennitted to not be less than NPS 3/4 in size.
- A full-flow strainer with a valved blow-off connection shall be installed in the main feeder line to the spray system. The maximum size of the opening in the strainer shall be 0.25 in. A full-size valved bypass shall be provided. Galvanized piping shall be considered downstream of the strainers to reduce the potential for rust scale plugging spray nozzles.

8.4.4 Portable Equipment

Portable equipment, such as fire hoses and portable monitors, shall not be used as the only means of protecting exposed LPG vessels. It is permitted to use portable equipment when vessels are fireproofed.

8.4.5 Fire Water Application Rates

The minimum required fire water application rate depends on the method of application.

In determining fire water application rates, the surface area of the vessel that could be exposed to fire shall be the surface area of the vessel above the level of the liquid contents at the vessel's lowest operating level.

Fixed deluge or water spray systems shall be designed to protect against pool fire exposure to the vessel with a minimum fire water application rate of 0.10 gallon per minute per square foot of exposed vessel surface.

To compensate for losses due to wind and vaporization that occur before the stream reaches the vessel wall, fire water monitor systems shall be designed to protect against pool fire exposure to the vessel with a minimum water application rate of 0.20 gallon per minute per square foot of exposed vessel surface.

8.5 Fire Detection Systems

A safety analysis shall be used to determine the need for fire and hydrocarbon detection systems. Where provided, fire and hydrocarbon detection systems shall be arranged to sound their alarms whenever fire or hydrocarbons are present. It is permitted to use detection systems to automatically activate isolation or fire protection systems in remote or unattended facilities.

8.6 Fire Extinguishers

Portable fire extinguishers shall be used to extinguish an LPG fire only after the source of LPG has been shut off, to prevent the formation of a hazardous vapor cloud.

Dry chemical fire extinguishers shall be provided at strategic locations such as those near pumps and loading racks so that they are readily available for operator use.

8.7 Fire-Fighting Foam

Fire-fighting foam shall not be used to extinguish LPG fires.

8.8 Fireproofing of LPG Vessels

Except for remote facilities, which require no protection, fireproofing shall be used to protect vessels if portable equipment is the only means of applying fire water.

Where fireproofing is used, it shall provide protection of the structural steel or LPG vessel for the time period required for operation of fire water systems.

When fireproofing is used, it shall comply with the following provisions:

- Outside surfaces of LPG vessels that may be exposed to fire shall be covered with a fireproofing material that is suitable for the temperatures to which the vessel will be exposed.
- The thickness of the fireproofing material should be equivalent to a fire endurance of 1112 hours per UL 1709 when tested on a lOW49 column.
- Thermal insulation used for fireproofing shall be jacketed with rust-resistant steel.
- The fireproofing material shall be suitably protected against weather damage and sealed to prevent water entry.
- The fireproofing system shall be capable of withstanding exposure to direct flame impingement and shall be resistant to dislodgment by direct impingement of fire water streams. Refer to NFPA 58, Appendix G, for further information.

8.9 Fireproofing of Structural Supports

Except for remote facilities, which require no protection, structural supports shall be provided with fireproofing, as specified below:

- Fireproofing shall be provided on the aboveground portions of the vessel's supporting structures. The fireproofing shall cover all support members required to support the static load of the full vessel. Fireproofing shall not encase the points at which the supports are welded to the vessel.
- Fireproofing shall be provided on horizontal vessel saddles where the distance between the bottom of the vessel and the top of the support structure is greater than 12 in. Where such fireproofing is provided, it shall extend from the support structure to the vessel, except that it shall not encase the points at which the saddles are welded to the vessel.
- When a vertical vessel is supported by a skirt, the exterior of the skirt shall be fireproofed.
- Fireproofing shall be provided on all pipe supports within 50 ft of the vessel and on all pipe supports within the spill containment area of the vessel.
- To be considered as adequately fireproofed, support structures of concrete or masonry shall have a fire endurance of 1112 hours per UL 1709 when tested on 10W49.
- Fireproofing is not required for diagonal bracing, including tie rods, or for redundant members that are not necessary for supporting static loads.
- The thickness of the fireproofing material should be equivalent to a fire endurance of 1112 hours per UL 1709 when tested on a lOW49 column.
- Fireproofing material shall be suitably protected against weather damage and sealed to prevent water entry. It shall be resistant to dislodgment by direct impingement of fire water streams.
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8.10 Electrical Installations & Equipment

All electrical installations and equipment shall conform to the provisions of NFPA 70. Refer to API RP 500 or 505 for guidance in the classification of electrical areas.

8.11 Critical Wiring & Control Systems

Unless the electrical, instrument, and control systems are fail-safe in a fire, these systems-including especially the wiring used to activate the equipment needed in an emergency-shall be protected from fire damage. Thus, in areas where the control wiring used to activate an emergency shutoff valve during a fire could be exposed to the fire, the wiring shall be protected against a IS-minute fire exposure; however, if activation of an emergency shutoff valve would not be necessary during any fire to which its wiring could be exposed, then protection of the wiring is not required.

Wiring shall be protected by selective routing, burying, fireproofing, or a combination of these methods.

8.12 Safety Precaution Signs

Appropriate safety precaution signs shall be placed to provide notification and instructions concerning safety requirements and emergency systems.

8.13 Lighting

In all storage and operating areas, lighting that is adequate for operations under normal conditions shall be provided. In addition, lighting that is sufficient to enable safe operations during an emergency shall be provided.

8.14 Fencing

Any LPG storage installation that is not within a fenced plant area or otherwise isolated from the public shall be fenced, and at least two means of exit shall be provided. Exits shall be located so that a single emergency cannot prevent egress from any part of the installation.

8.15 Roadways

Suitable roadways or other means of access for fire-fighting equipment such as wheeled extinguishers or fire trucks shall be provided. Access to LPG handling and storage areas shall be restricted or controlled.

9.0 ANALYSIS OF ALTERNATIVES

In order to enable the proposed project to seek different ways of minimizing its impacts on the environment and at the same time achieve its objectives several alternatives were assessed.

9.1 The Zero Option

The “zero option” represents a situation which would result if the project was not implemented. In this case, both the positive and negative impacts of construction and operation the project would not occur. This option will however, involve several losses both to the landowner and the country as a whole. The landowner continues to pay rent on the land while the property remains underutilized. The major impact of not proceeding would be the loss of expected benefits. These include:

- Lack of enough construction materials within the county
- The local skills would remain under-utilized.
- No employment opportunities will be created

9.2 Alternative land use/site

Relocation option to a different site was assessed. In this case the proponent will have to look for another land to implement the project. However due to scarcity and high cost of acquiring land in the area, and pressure on the existing land; the option may not be viable. In addition the project site will continue to remain under-utilized and this will lead to a situation like No Project Alternative option.

9.3 Alternative construction materials and technology

Alternative building technologies available include use of conventional brick and mortar style, prefabricated concrete panels, or even temporarily structures. Due to cost and durability, the natural stones and mortar style is the most popular more so in Kenya.
The technology to be adopted will be the most economical and one sensitive to the environment. Heavy use of timber during construction will be discouraged because of destruction of forests. The exotic species will be preferred to indigenous species in the construction where need will arise.

9.4 Alternative schedule

This option entails carrying out the project at a later time thereby offsetting the possible impacts at the current time. The only benefit is the hope that in future there may be improvements in baseline conditions and implementation technologies. However these conditions are not guaranteed and may only amount to delays in the project implementation. Therefore carrying out the proposed project with the proposed mitigations would be the most preferred option due to future uncertainties. In addition carrying out the proposed project at later time may lead to more operational and logistic costs due to increasing inflation and standards of living.

9.5 Alternative designs

This option entails undertaking the project but with different project designs. However the current plan layout has been achieved by considering all the options available that would ensure cost-effectiveness, quality and avoid or reduce environmental and social impacts as much as possible.

9.6 Waste water management alternatives

9.6.1 Wastewater/sewage management

(i) Water treatment plant

This involves construction of a plant and use of chemicals to treat the effluents to locally accepted environmental standards before it is discharged into the environment. It is usually expensive to construct and maintain, and need more space, but it is the most reliable, efficient and cost-effective in the long term. The sludge obtained can be composted and used for agricultural and gardening purposes. The option is not preferable due to lack of space and the existing alternatives as outlined below.

(ii) Use of stabilization ponds/lagoons

This refers to use of a series of ponds/lagoons that allow several biological processes to take place, before the water is released back to the river. The lagoons can be used for aquaculture purposes and irrigation. However, they occupy a lot of space but are less costly. No chemicals are used, heavy metals sink and decomposition processes take place. However they are usually a nuisance to the public because of odour from the lagoons/ponds. This option is not preferable in the area due to these factors and space available.

(iii) Use of Constructed/Artificial wetland

This is one of the powerful tools/methods used in waste management in the developing countries. Constructed wetland plants act as filters for toxins. The advantages of the system are the simple technology, low capital and maintenance costs required. However, they require space and a longer time to function. Long term studies on plant species on the site will also be required to avoid weed biological behavioural problems. Hence not the best alternative because of the large amount of land required.

(iv) Use of septic tanks

This involves construction of underground concrete-made tanks to store the sludge with soak pits. This option is viable in instances where the project is far from a sewer line. The method is made expensive due to construction technology and regular exhaustion.

(v) Connection to a sewer line

This involves connecting into a sewer line managed by the local water provider who runs a sewage treatment plant. This is the best option in municipalities and towns.

9.6.2 Solid waste management alternatives

Waste management alternative will include the following.

- Waste reduction at source: recycling, reuse and composting of the waste.
- Collection and disposal by CGK or a licensed waste company

In conclusion the collection and disposal by the local authority is the most viable option. However measures on waste reduction at the sources, segregation, recycling and reuse will also enhance waste management.

8.7 Conclusion on project alternatives

Implementation of the project with the proposed mitigation measures is the most preferred option as it entails carrying out the project with mitigation measures to prevent, offset or avoid its negative impacts thereby maximizing it gains. This option will therefore lead to achieving the project's objectives sustainably and contribute to the achievement of other policy goals and sector objectives.

10.0 DECOMMISSIONING

10.1 Introduction

Decommissioning is the last phase of project life. This involves demolition of the project also known. After a project completes its life cycle, the site has to be rehabilitated to its/close to its original state. Decommissioning of a project can also be undertaken if a building is declared a safety hazard as a result of poor workmanship during/after construction or when natural calamities such as earthquakes occur and destabilise the building.

10.2 Demolition

A lot of expertise will be required to avoid environmental damage (air pollution, noise pollution), occupational hazards and loss of property during the demolition phase. Therefore the following have to be considered before undertaking the demolition process:-

- The general public to be informed of demolition exercise well in advance by placing notices in public places concerning the intended demolition at least two weeks in advance;
- The LPG storage and bottling Facility must be sealed off from public access;
- The firm commissioned to demolish must have enough relevant machines and equipment such as high cranes, fleet of dumpers, dozers that will enable the work be undertake smoothly and be completed within stipulated time;
- The firm must have experienced labour force to undertake the exercise;
- Adequate measures to be put in place to minimise environmental degradation;
- Site supervision from relevant Central Government Departments and Local Authorities to be in place throughout the exercise;
- Waste materials resulting from demolition must be handled and disposed according to environmental requirements and procedures;
- Care must be taken to avoid destruction of trees and other vegetation on site during the exercise.

10.3 Considerations

- All employees involved in the demolition exercises must have proper protective gear throughout;
- Demolition should be done during day time only unless it's an emergency;
- Waste resulting must be disposed at designated waste disposal sites;
- All relevant arms of government must be involved in the exercise; and
- Emergency services such as first aid and ambulance services must be on standby in case of any eventualities.

10.4 Support infrastructure on site

Support infrastructure such as water reservoirs, and sewage facilities should be handled with care.

The following should be taken into consideration: -

- If water reservoirs contain water, empty them first before demolition;
- Put temporally potable tanks on site to hold the water which can be used in dust arresting while demolition is on;

- Sewage facilities such as soak pits and sceptic tanks must be emptied first; and
- Seek professional advice from Gusii Water and Sewage Company on their decommissioning.

10.5 Site rehabilitation

Once demolition is complete rehabilitation of affected site should be undertaken to its original state or close to original state. Site rehabilitation will include the following: -

- Test and analysis of soil from site should be undertaken before rehabilitation begins;
- Planting of appropriate species of trees, shrubs and grasses;
- Ensuring they are regularly watered, weeded in their early stages to ensure survival;
- The area should be fenced off while rehabilitation is in progress to avoid damage to tender trees planted.

10.6 Disposal of land

The land on which the LPG storage and bottling facility will lie is leasehold. Therefore once site rehabilitation is complete the proponent will hand it over to the owner who will decide what to do with it.

10.7 Environmental Management Plan-Decommissioning Phase

In addition to the mitigation measures provided in table above, it is necessary to outline some basic mitigation measures that will be required to be undertaken once all operational activities of the proposed project have ceased. The necessary objectives, mitigation measures, allocation of esponsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning &closure phase of the proposed project are outlined in table 1 0 . 1 below.

Environmental issue	Proposed measures	Timeframe	Responsibility	Cost (KES)
Site clean up				
	- Removal of all fixed and mobile machinery. - Removal of all permanent and temporary structures. - Removal and safe disposal of any hazardous or contaminated materials - Rehabilitation of surplus internal roads, office sites, including breakup of concrete slabs.	At decommissioning	Proponent and contractor	500,000
Re-vegetation				
	- Fertilize the areas to be re-vegetated if need be. - Plant grass and bushes to prevent soil erosion and facilitate the formation of humus - Ensure that the characteristic of the vegetation to be planted resembles that of the natural environment - The vegetation must be self-sufficient six years after planting and Require no fertilizing or maintenance.	At decommissioning	Proponent and contractor	300,000
Management of Sanitary installations				
Sanitary	- Must be emptied by NEMA Licensed waste handlers.	Once off at	Proponent and	Implementating

installations		decommissioning	contractor	budget

Environmental issue	Proposed measures	Time	Responsibility	Cost (KES)
Management of Solid waste				
Demolition waste	- All solid wastes from this phase, should be handled by a NEMA licensed waste handler. - Use of an integrated solid waste management system i.e. through a hierarchy of options: Source reduction, Recycling, Composting and reuse, Combustion Sanitary Land filling. - Encourage reuse, and recycling is encouraged to reduce the disposable waste.	Once off at decommissioning	Proponent and contractor	1,000,000

Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
1. Demolition waste management			
1. All buildings, foundations, equipments, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible	Contractor/ Proponent	One-off	-
2. Dispose reusable demolished facilities as prescribed by public procurement and disposal Act 2005, Cap412C.	Contractor/ Proponent	One-off	-
3. Where recycling/reuse of the equipments, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site	Contractor/ Proponent	One-off	
4. Restore the project site to its original status by implementing an appropriate re-vegetation program and consider using indigenous plants	Contractor/ Proponent	One-off	As per budget

11.0 CONCLUSION & RECOMMENDATION

The proposed installation of LPG storage and bottling facility has the support of the neighbors and stakeholders, Impacts Mitigation measures have been factored and if properly used, we believe the negative impacts will be significantly reduced.

The installation and commissioning of the LPG Storage and Filling plant is also expected to translate to high economic returns on investment. The government and the local population will benefit through taxation income and employment opportunities respectively. This proposal therefore considers the plant beneficial.

List of Appendices

Appendix	Description
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Appendix 2:	Lease Agreement
Appendix 3:	Expert license
Appendix 4:	Plant layout Plan
Appendix 5:	KRA PIN copy
Appendix 6:	Site google earth Map
Appendix 7:	Photo Logs
Appendix 8:	Map with coordinates
Appendix 9:	Public Participation Questionnaire

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