ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

AUGMENTATION AND REVAMPING OF LPG BOTTLING PLANT SALEM, TN

SUBMITTED TO

M/s INDIAN OIL CORPORATION LIMITED

PREPARED BY

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CHAPTE R 1. INTRODUCTION

1.1 INTRODUCTION

M/s Indian Oil Corporation Ltd. proposes expansion and successful operation of Salem Bottling Plant, from 1200 MT to 2700 MT by increasing the bottling capacity of 44TMTPA to 120TMTPA and introducing 3 mounded bullets of each 900 MT capacity after dismantling the existing spheres and above ground bullet.

As per EIA Notification, published in Gazette of India, Extraordinary Part-II, Section-3, sub-section (ii) of Ministry of Environment & Forest dated 14.09.2006 & subsequent amendments, the proposed project falls in Activity 6(b), Category-B of "List of Projects or Activities Requiring Prior Environmental Clearance". As per the above notification, proposed project will have to obtain Environmental Clearance.

1.2 Identification of Project and Project Proponent

1.2.1 Project Proponent

Indian Oil Corporation Limited (IOCL) is a government of India enterprise with a Maharatna status, and a Fortune 500 and Forbes 2000 company. Incorporated as Indian Oil Corporation Ltd. on 1st September, 1964 Indian Oil and its subsidiaries account for approximately 48% petroleum products market share, 34% national refining capacity and 71% downstream sector pipelines capacity in India. It is India's flagship national oil company and downstream petroleum major thus being India's largest commercial enterprise.

As the flagship national oil company in the downstream sector, Indian Oil reaches precious petroleum products to millions of people every day through a countrywide network of about 35,000 sales points. They are backed for supplies by 167 bulk storage terminals and depots, 101 aviation fuel stations and 90 Indane (LPG) bottling plants.

Indian Oil Corporation Ltd. (IOCL) is a premier public sector company in the Oil & Gas Sector and is engaged in the business of refining and retailing of petroleum products including LPG in the country. It is the leading Indian corporate in the Fortune 'Global 500' listing, ranked at the 83rd position in the year 2012. IOCL is having about 90 LPG bottling plants, which serve every corner of the country. Indane (the trade name of LPG of IOCL) is supplied to the consumers through a network of about 5,456 distributors (51.8% of the industry).The growth in demand of LPG for domestic purpose is increasing at a rapid pace.

1.2.2 Identification of Project

IOCL is having about 90 LPG bottling plants which serve every corner of the country. Indane (the trade name of LPG of IOCL) is supplied to the consumers through a network of about 5,456 distributors (51.8% of the industry).The growth in demand of LPG for domestic purpose is increasing at a rapid pace.

The current Plant capacity is 44 TMTPA in 2 shift operations. Plant has two Horton Spheres each of 600MT and 500 MT storage capacities to store bulk LPG. Apart from these it also has one 100 MT Bullet for storage of Bulk LPG.
Operation carried out will be receipt of LPG (Liquid Petroleum Gas) by road tankers from IPPL, Chennai; after receiving of bulk LPG in isolated storage vessels and filling of LPG into domestic and non-domestic cylinders using electronic carousels and associated systems.
The proposed project is to increase the capacity from 44TMTPA to 120TMPTA as well as additional mounded storage will be in 3 bullets of 900 MT each with a total capacity of 2700 MT.
Salem LPG Bottling Plant takes care of the demand of 5 districts of Tamilnadu.

Land ownership document and Air & water consents are enclosed as **Annexure-I & II** respectively.

The gas leak detection, fire prevention and control system at Salem LPG Bottling Plant are the latest and comply with the OISD norms. The same shall be extended to the new LPG vessels. All LPG storage vessels, cylinder storage/ filling/ repair sheds, LPG Pump House and TLD are fully covered by medium velocity water spray system. This Bottling Plant will also cater to the non-domestic LPG demand, Bulk LPG and Auto LPG demand of Salem. The proposed additional facilities in Plant are estimated to cost of Rs.97.0 Crores.

1.2.3 Justification of Project

In the Proposed augmentation works planned the storage will be pressurized form in mounded storage. The existing Horton spheres and bullet would be dismantled and mounded storage in 3 bullets of 900 MT each with a total capacity of 2700 MT. In order to augment the capacity of the Plant to 120 TMTPA additional Carousel is proposed to be included. Modification to facilities like shifting the existing TLD unloading bays and LPG Pump house would also be carried out to accommodate the Mounded Storage Vessels.

Modification is also proposed to the existing Filling Shed to accommodate additional Carousel. Administration Building and S & D building are to be relocated in the revised layout. Provision has also been made to receive bulk LPG through pipelines in future.

1.2 Schedule and cost of the project

The proposed project will be completed in approximately 24 months from the date of approval environmental & other statutory clearances. The total cost of the proposed project is around Rs 97 Cr

1.3 Brief Description of the Project

1.3.1 Nature of the Project

The Liquefied Petroleum Gas (LPG) is received in bulk through LPG tankers/ pipeline, and transferred to storage vessels. LPG is then filled in to cylinders by operating LPG Pump.LPG brought from above mentioned sources are stored into all the LPG Storage Vessels.

The empty LPG cylinders brought into premises by Lorries are received and stored in the empty shed. They are fed to carousels / filling gun after due inspection through conveyor system in the filling shed. The filling is cut off as soon as the weight of LPG in the cylinder reaches 14.2/19 kg. After filling, these cylinders are counter checked for correct weight, tested for leaks from valves and body, capped and sealed before sending them to the filled cylinder shed. Any defective cylinder is emptied at evacuation unit and sent for cold repair in the "Cold Repair" shed.

1.3.2 Size of the Project

In the LPG Bottling Plant the additional storage will be pressurized form in mounded storage. The mounded storage will be in 3 bullets of 900 MT each with a total capacity of 2700 MT. The system of mounded storage has been recognized as one of the safest form of storage of LPG. The details of existing and proposed LPG storage and bottling plant capacities are provided in **Table-1.1**.

Table 1.1: Existing And Proposed - LPG Storage

Type of Vessel	Existing/Proposed	Nos.	Capacity	Total Capacity
Bullets (A/G)	Existing	1	100 MT	100 MT
Horton Sphere	Existing	1	600 MT	600 MT
Horton Sphere	Existing	1	500 MT	500 MT
			Total	**1200 MT**
Mounded Storage	Proposed	**3**	**900 MT**	**2700 MT**

Source: IOCL

1.3.3 Location of the Project

The Plant site is located at a distance of 3 km from the Karuppur railway station and 8 Km from Salem railway station. The site is well connected to through NH-7, which is abutting the site in South direction. The nearest Airport- Coimbatore is located at 170 km in South West direction. The details of environmental setting are given in **Table 1.2**. The index map of the project site is shown in **Figure 1.1**.

Table 1.2: Environmental Setting

Sr. No.	Particulars	Details
1	Plant location	Located in Karuppur, Salem district, State Tamil Nadu
2	Site Coordinates	Latitude : 11^0 71' N Longitude : 78^0 14' E
3	Climatic conditions at **SALEM (1901-2003)**	
4	Maximum temperature	36.7 ^{0}C
5	Minimum temperature	18.6 ^{0}C
6	Annual rainfall (total)	800-1600 mm
7	Relative humidity	Maximum- 72 % (August) Minimum- 48 % (May)

Sr. No.	Particulars	Details
8	Predominant wind directions	Annual:- East
9	Plant site elevation above MSL	308. 00 m
10	Plant site topography	Plain
11	Present land use at the site	Commercial land
12	Nearest highway	NH-7, abutting, South
13	Nearest railway station	Karuppur RS- 3Kms
14	Nearest Airport	Coimbatore- 170 Km, SW
15	Nearest major water bodies	Cauvery River 50 Km SW
16	Nearest town/City	Salem, 10 km
17	Nearest village	Karuppur , 2 kms
18	Archaeologically important places	Nil
19	Protected areas as per Wildlife Protection Act, 1972 (Tiger reserve, Elephant reserve, Biospheres, National parks, Wildlife sanctuaries, community reserves and conservation reserves)	Nil
20	Reserved / Protected Forests	• Nil
21	Defence Installations	• Nil
22	List of major Industries in 10 km radius	• Salem Steel Plant, SAIL – 25.5 km, S • Dalmia Magnesite - 6.6 km, SE • Burns Standard & Co Refractories –3.5km, SE • TANMAG – 6.5 km, SE • SIDCO Womens Industrial Park – 1.9 Km W
23	Seismicity	Seismic Zone-III as per IS 1893 (Part I): 2002

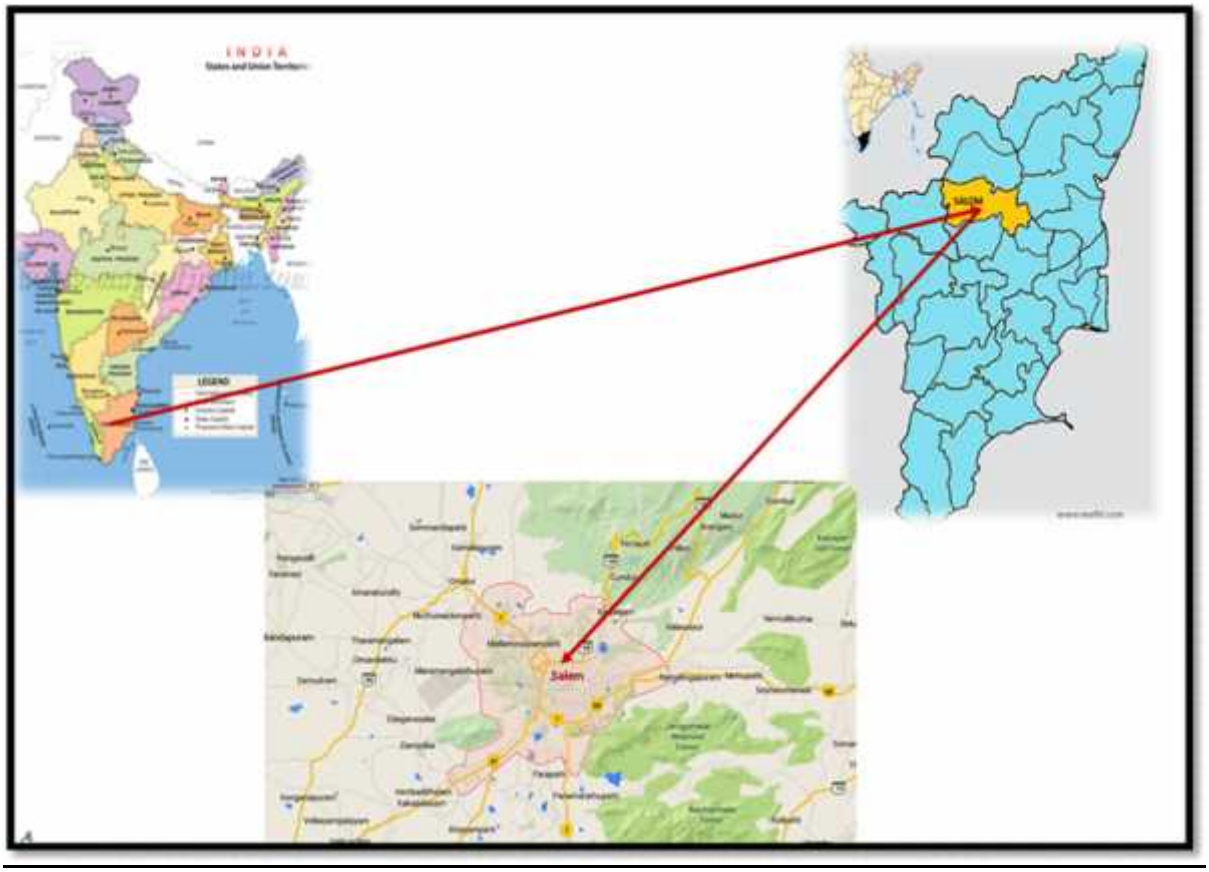


Figure 1.1: Index Map Showing the Project Site

1.3 Market Demand & Supply

India consumes about 16 MMTPA of LPG while domestic production is only 10 MMTPA. Net import of LPG is about 6 MMTPA. The consumption, import and export from last 5 years are presented in **Table 1.3**. During last 4 years, LPG consumption has grown at GAGR of 5.6% while production is almost static hence import has increased at CAGR of 25%.

Table 1.3: LPG Demand

LPG	2009-10	2010-11	2011-12	2012-13	2013-14
Consumption	13.13	14.33	15.35	15.60	16.34
Production	10.34	9.62	9.55	9.83	10.11
Export	0.13	0.15	0.17	0.20	0.23
Import	2.72	4.48	5.79	6.29	6.60

1.4 Scope of the Study

With a view to assess the environmental impacts arising due to the proposed expansion of LPG storage facility, IOCL has availed the services of M/s Ultra-Tech Environmental Consultancy and Laboratory, to prepare the EIA Report and suggest an Environmental Management Plan (EMP) for mitigating adverse impacts from the proposed expansion project.

Environmental baseline monitoring has been carried out by M/s. Eco Services Labs Pvt. Ltd. Chennai during January to March 2016. The scope of the present study is in-line with the Standard Terms of reference as recommended by State Environmental Appraisal Committee (SEAC).

1.4.1 Study Area Details

The study area for the present EIA study is the area covered within the 10 km radius from the boundary of the facility. The topographical features of the study area are shown in **Figure-1.2**. Google image of the study area is shown in **Figure-1.3**

1.4.2 Details of the Study

The scope of study broadly includes:

- To conduct literature review and to collect data relevant to the study area;
- To undertake environmental monitoring so as to establish the baseline environmental status of the study area;
- To predict incremental levels of pollutants in the terrestrial study area due to the proposed project activities;
- To evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies;
- Risk Assessment study;
- To prepare an EMP outlining the measures for improving the environmental quality and scope for future expansions for environmentally sustainable development; and
- To identify critical environmental attributes required to be monitored suggesting a post-project monitoring programme.

The literature review includes identification of relevant articles from various publications, collection of data from various government agencies and other sources.

1.4.3 Methodology of the Study

Reconnaissance survey was conducted by the consultants and concerned officials and sampling locations were identified on the basis of:

- Predominant wind directions in the study area as recorded by India Meteorological Department (IMD) at Salem
- Existing topography, drainage pattern and location of surface water bodies like ponds, canals, and rivers;
- Location of villages/towns/sensitive areas;
- Areas which represent baseline conditions; and
- Collection, collation and analysis of baseline data for various environmental attributes.

The field observations are used to:

- To observe the baseline environmental status of study area;

- Identify extent of negative impacts on community/natural resources; and
- Identify mitigation measures and monitoring requirements.

The study also provides framework and institutional strengthening for implementing the mitigation measures. Field studies have been conducted to determine existing conditions of various environmental attributes as outlined in **Table-1.4**.

Figure 1.2: Study Area Map of the Project (10 Km Radius)

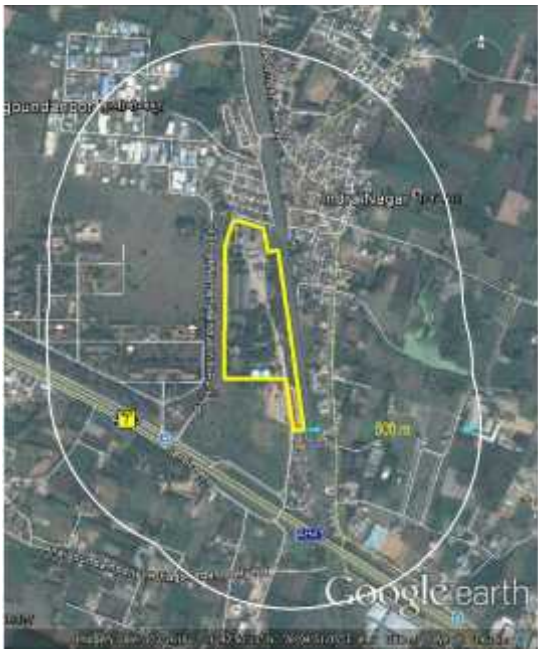


Figure 1.3: Google Image

Table 1.4: Environmental Attributes and Frequency of Monitoring Adopted

Sr. No.	Environmental Component	Sampling Locations	Sampling Parameters	Sampling Period	Sampling Frequency	Methodology
1	Meteorology	One central location	Temperature, Wind Speed, Wind Direction	3 months	Hourly	The parameters were recorded by automatic micro-meteorological machine having anemometer, wind vane and thermometer. IMD data of Salem also reviewed.
			Rainfall	3 months	Daily	Rainfall was recorded every morning at 0830 hours
			Relative Humidity, Cloud Cover	3 months	Hourly	Humidity measured using wet & dry bulb thermometer and psychometric charts on hourly basis.
2	Ambient Air Quality	8 locations	As per NAAQS 2009- PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO, O_3, As, Ni, Pb, C_6H_6, BaP, NH_3	Two days per week for 13 weeks	24 hourly	Gravimetric method for $PM_{2.5}$ and PM_{10}. Modified West & Geake method for SO_2 (IS-5182 part-II 1969) using Tetrachloromercurate 0.01 N absorbing solution. Jacob-Hochheiser method (IS-5182 part-IV 1975) for NOX using Sodium Arsenate absorbing solution of 0.01 N absorbing solutions. CO was measured by GC method.
3	Water Quality	10 locations (2-Surface water 8-Ground water)	As per IS:10500-2012	Grab sampling	Once in study period	As per APHA methods. The conductivity, temperature were analyzed at site laboratory and rest of the parameters were analyzed at M/s. Eco services India Pvt. Ltd., Chennai
			Heavy metals (As, Hg, Pb, Cd, Cr^{-6}, Total Cr, Cu, Zn, Se, Fe)	Grab sampling	Once during study period	
4	Noise	8 locations	L_{eq}, L_{day}, L_{night}, $L_{D/N}$	Hourly readings for 24 hours	Once during study period	Integrated on hourly basis
5	Soil	8 locations	Soil profile, Chemical constituents, Suitability for agricultural growth	Composite sample up to 90-cm depth	Once during study period	Analysis was carried out as per Soil Chemical analysis by ML Jackson
6	Terrestrial Ecology	Total study area	Flora and fauna	Field observations	Once during study period	Through field visits and collected secondary data. Count and quadrate method
7	Demography and Socio-economic aspects	Total study area	Demographic profile	-	-	Through field visits and secondary information sources like National Informatics Centre, Delhi, Census, etc.

CHAPTER 2. PROJECT DESCRIPTION

2.1 Type of the Project

Salem LPG Bottling Plant (BP) operates strictly as a storage & packing facility for LPG. No by-products / additional products are generated / manufactured during the operations. Hence, the present proposal is classified under Schedule 6(b) & Category 'B' according to EIA Notification 2006 & subsequent amendments.

2.2 Need for Project Activity

The Salem BP was commissioned in 1983. There is ever increasing demand for LPG cylinders. The Plant currently has 5.0 days cover against a bottling capacity of 215 MTD. This poses the following inconveniences:

- Any disruption in supplies from IPPL, Chennai or any operational reasons like berthing delays of LPG tankers at IPPL, there can be dry-out situations and may also lead to procure bulk LPG from non-economical sources.
- With small size vessels and dead stocks (unpumpable), the effective transfer/receipt quantity is even less which calls for frequent, switch-over between vessel under receipt and vessel engaged for cylinder bottling.
- Residual lives of 2 nos existing old Horton spheres and A/G bullets are limited. Any further reduction in storage would lead to severe constraint in day-to-day operation and a crisis situation.
- The plant is situated at a nodal place wrt to LPG market and hence is vital for meeting the demand of the market.

In view of the foregoing, IOCL proposes for provision of augmenting the storage capacity by providing 3 nos of mounded bullets with 900 MT capacities each in the plant which will ensure 7-8 days cover on a stand-alone basis against total bulk LPG storage capacity of 2700 MT. In order to meet the growing demand, other augmentation works of facilities planned would ensure to increase the bottling capacity to 120 TMTPA. The augmentation at the BP is estimated to cost approximately INR. 97.0 Crores.

2.3 Location and Layout

The layout of the bottling plant has been prepared as per prescribed OISD-144 & 150. The road network is designed to ensure smooth movement of bulk/filled cylinder trucks. Layout plan of the bottling plan including proposed facilities have been given in **Figure 2.1**.

- Design Parameters: Temperature, Pressure, Internal Corrosion, Hydro Test Pressure
- Design Procedure: As per the Design Code: ASME SEC. VIII or PD - 5500 or equivalent duly approved by PESO.
- Piping layout is as per OISD-150. One liquid line, one vapour line, 2no's SRVs, ROVs on liquid and vapour lines

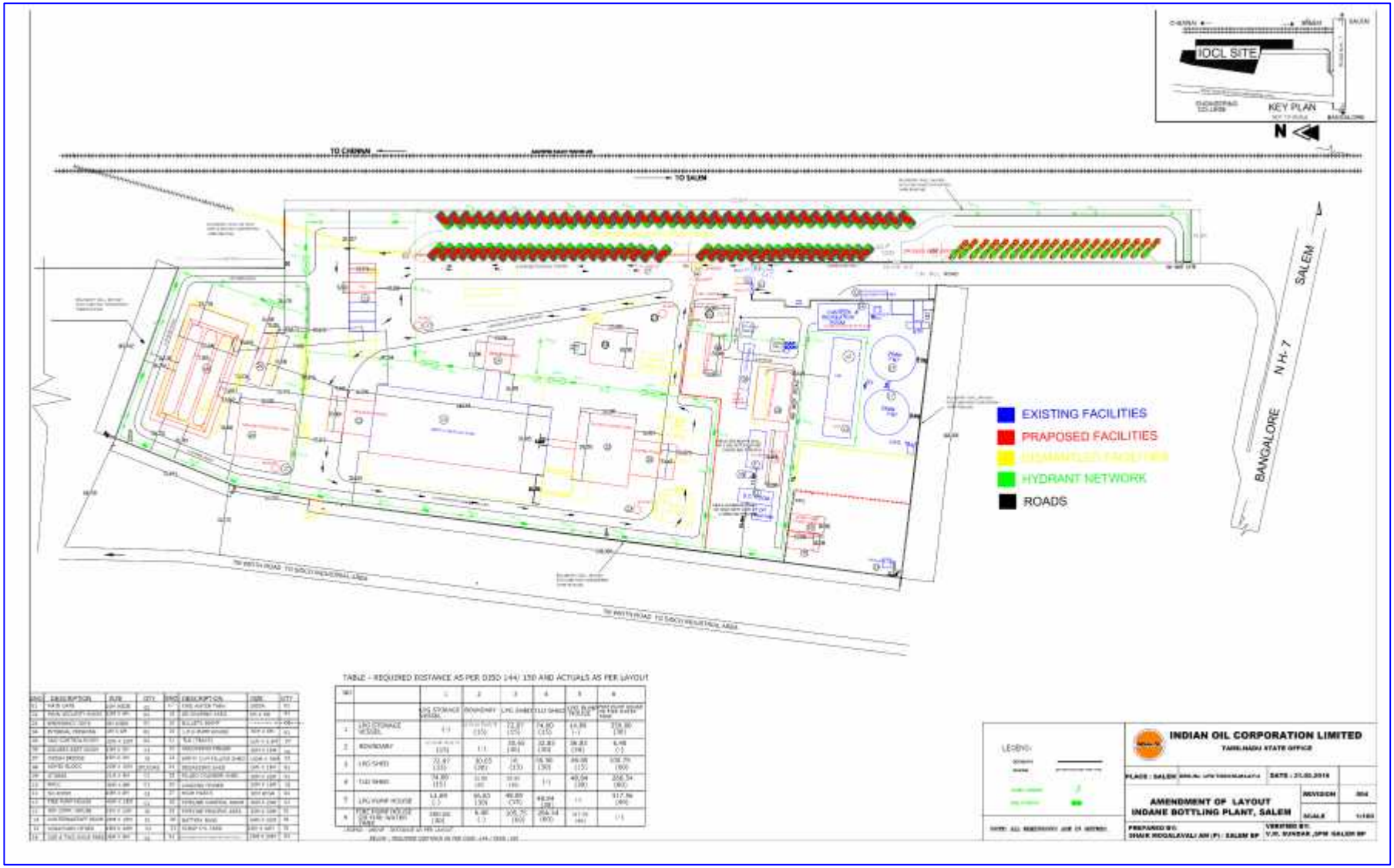


Figure 2.1: Layout of the Plant

2.4 Salient Features of the Project

The salient features of the proposed augmentation of Salem LPG BP are presented in **Table 2.1.**

Table 2.1: Salient Features of Existing and Proposed Plant

<table>
<tr><th>Sr. No.</th><th>Description</th><th>Details</th></tr>
<tr><td>1</td><td>Total Land</td><td>21.55 acres</td></tr>
<tr><td>2</td><td>Location</td><td>Latitude : 11°42’49.46 N
Longitude: 78°05'28.84 E
Dist: Salem
State: Tamil Nadu</td></tr>
<tr><td>3</td><td>Land Use</td><td>No change .Proposed expansion will be carried out within existing premises</td></tr>
<tr><td>4</td><td>Status of land acquisition</td><td>NA. Entire land is in the posssesion of IOCL.</td></tr>
<tr><td>5</td><td>Type of Storage Tanks</td><td>1. Mounded Bullet</td></tr>
<tr><td>6</td><td>Capacity of Storage Tanks</td><td>
<table>
<tr><th>Sr. No</th><th>Type of vessel</th><th colspan="2">Storage (MT)</th></tr>
<tr><td></td><td></td><td>Existing*</td><td>Proposed</td></tr>
<tr><td>1</td><td>Horton Sphere</td><td>500</td><td>--</td></tr>
<tr><td>2</td><td>Horton Sphere</td><td>600</td><td>--</td></tr>
<tr><td>3</td><td>Bullet A/G</td><td>100</td><td>--</td></tr>
<tr><td>4</td><td>Mounded Bullets</td><td>--</td><td>2700</td></tr>
<tr><td colspan="4">* To be dismantled</td></tr>
</table>
</td></tr>
<tr><td>7</td><td>Power requirement</td><td>Approx. 450kVA from TN State Electricity Board</td></tr>
<tr><td>8</td><td>Water requirement</td><td>25 m^3/day</td></tr>
<tr><td>9</td><td>Man power</td><td>Existing : 150 Proposed : 100</td></tr>
<tr><td>10</td><td>Project Cost</td><td>INR 97Cr</td></tr>
<tr><td>11</td><td>Cost towards environment protection</td><td>Rs 1.50 Crores</td></tr>
<tr><td>12</td><td colspan="2">Fire Fighting Facilities</td></tr>
<tr><td>A</td><td>Fire water storage</td><td>11400 KL</td></tr>
<tr><td>B</td><td>Fire water pumps</td><td>5 fire water pumps of 615 cum/ hr</td></tr>
<tr><td>C</td><td>Jockey pumps</td><td>2 jockey pumps of 30 m^3/hr@7kg/cm^2</td></tr>
<tr><td>C</td><td>Water sprinkler / Deluge system</td><td>At all relevant places (will be converted to auto sprinkler system supported by PLC based ILSD)</td></tr>
<tr><td>D</td><td>Fire Hydrant/monitor piping network</td><td>As per OISD</td></tr>
</table>

Sr. No.	Description	Details
E	DCP & CO_2 extinguishers	As per OISD
F	Gas Monitoring System	As per OISD
G	ILSD	As per OISD-144

Source: Project Report, IOCL

2.4.1 Proposed Schedule and Approval for Implementation

The construction of LPG storage and TLD extension related activities will commence on receipt of Environmental Clearance (EC) from SEIAA, Tamil Nadu and Consent to Establish (CTE) from TNPCB.

2.4.2 Land Use

The proposed expansion will be carried out within the existing premises, the site earmarked for expansion is a vacant land and hence the no change in land use. Land schedule is given in **Table 2.2.**

Table 2.2: Land Schedule of the Project Site

Sr. No	Land Schedule	Area in ha
1	Plant facilities	5.10
2	Administrative building	0.05
3	Greenbelt	4.8
4	Truck parking	3.22

Source: Project Report, IOCL

2.5 Salem Bottling Plant Facilities

There is no process involved and the operations carried out will be receipt of LPG by pipe line/ road tankers, storage in Horton Spheres, AG/Mounded Bullets and filling of LPG into cylinders using carousel and associated systems.

The proposed mounded storage will be in 3 bullets of 900 MT capacities each with a total capacity of 2700 MT. The mounded storage has been recognized as one of the safest form of storage of LPG. The facilities at the LPGBP, Salem are shown in Table 2.3 (A&B).

Photographs of the existing Salem Bottling Plant are shown in **Figure 2.2** and the plant layout showing existing and proposed plant facilities is shown in **Figure 2.1**

Figure 2.2: Existing site photograph

Table 2.3(A): Facilities at the LPG Bottling Plant, Salem

Sr. No.	Facility	Quantity/Capacity	
		Existing	Proposed
1	Storage	1200 MT	2700 MT
2	Loading Bay	6	7
3	No. of Carousel	1	2
4	LPG Pumps	2	2
5	LPG Vapour compressor	4	4

Table 2.3(B): Storage Details of LPG

Scenario	BP Cap, TMTPA	Bulk Storage (MT)	Filing MT/day	Nodal Transfer, TMTPA	Days' Cover
Standalone BP Operation					
Existing BP capacity & storage	44	1200	215	NA	5
Future BP capacity & existing storage	120	2700	425	NA	7

From the above, it can be observed that the days' cover for Salem BP would be in the range of 7 days' after proposed tankage addition. Considering the BP being fed through pipeline, the same may be directionally on the higher side.

2.6 Description of Proposed Storage Facility

Proposed expansion of LPG storage facility is from 1200 MT to 2700 MT by installing 3x900 MT mounded bullet system and Truck Unload Facility extension.
The tanks will be installed above the highest known water table level and the soil cover, therefore, usually protrudes above ground level as an earth mound, thereby reducing the possibility of boiling liquid expanding vapour explosion' (BLEVE) happening. The mounded structure is shown in **Figure 2.3**

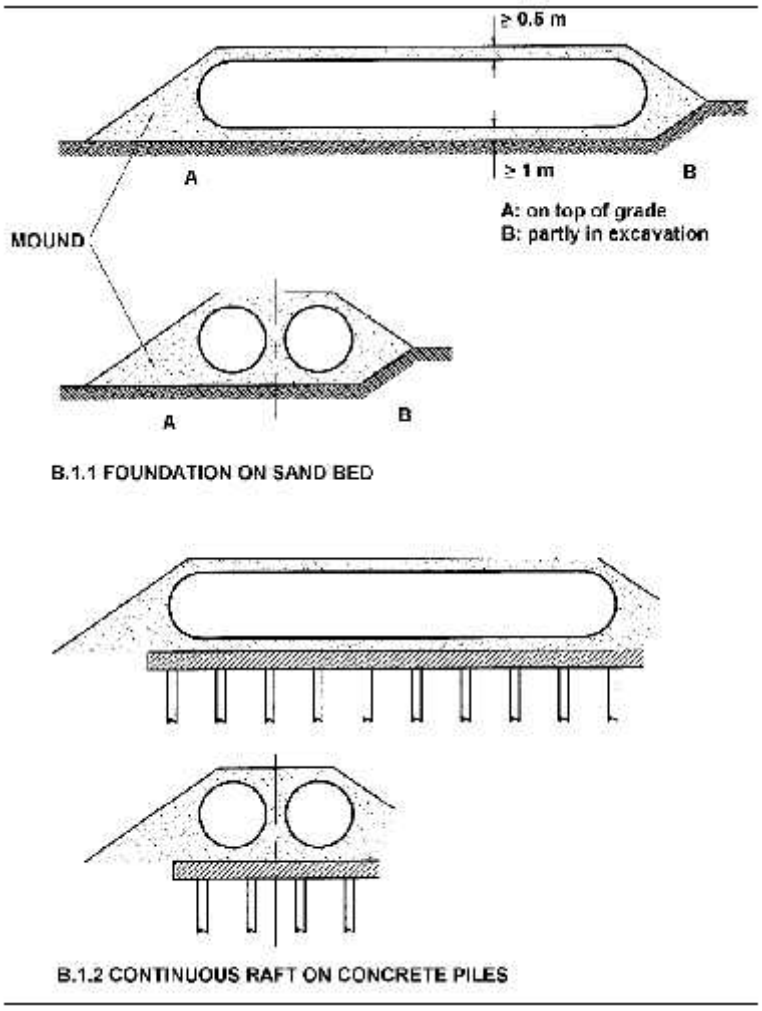


Figure 2.3: Mounded Storage Structure

Material safety data sheet of LPG is enclosed as **Annexure-III.**

Tank Accessories
The following accessories will be installed on storage tank: vents, access hatches, gauge float wells, gauge-hatches, sample wells, rim vents, roof drains, roof legs, un-slotted guide pole wells, slotted guide pole and vacuum breakers. The equipment for mounded tanks is given in

Table 2.4: Equipment for Mounded Tank

Parameter	Accessories on mounded tanks
Equipment for mounded tanks	Vents
	Still wells and guide poles
	Instrumentation
	Access hatches
	Drains
	Sealing elements
	Valves

Description of accessories is given below:

Vents: Pressure/vacuum relief valves (PVRVs)
Pressure relief valves prevent excessive pressure build-up and vacuum valves prevent the tank collapsing due to a negative pressure in the tank. These functions may be combined in a pressure/vacuum relief valve (PVRV), also known as a breather valve.

Still Well Guide Poles
Still wells and guide poles are installed to:

- ✓ enable access for measuring the liquid level;
- ✓ enable access for measuring the temperature of the liquid;
- ✓ enable access for sampling the liquid; and
- ✓ Prevent the roof from rotating.

Instrumentation
Local or remote instrumentation shall be in accordance with appropriate standards; the Institute of Petroleum (IP) Petroleum Measurement Manual and IP Electrical Safety Code will provide specific advice, as well as other codes, standards and guidelines in this field.

Level control and overfill protection
During filling procedures, usually it is insufficient to control and record only the filling level. Because there is a danger of overfilling and consequent soil and water pollution, storage tanks are equipped with overfill protection to interrupt automatically filling before the maximum authorised liquid level is reached. In case the filling is not carried out automatically, the tank is equipped with an alarm to indicate the maximum authorised liquid level is reached. And filling is stopped manually.

Flame arrester
LPG storage tanks will have flammable atmosphere above the liquid. To prevent vapours from being ignited, by an external source (e.g. lightening), vents are fitted with flame arresters. These will be regularly inspected to avoid blockage.

Leak and gas detection
Hydrocarbon detectors shall be installed to detect LPG liquid and/or gaseous leaks. The following is a non-exhaustive list of some typical techniques used:

- ✓ gas leaks can be detected by explosimeters, general purpose organic vapours analysers (OVA) or specific gas analysers; and
- ✓ Liquid leaks can be detected in the spillage collection systems. Level or interface level sensors can be used for insoluble organics, while pH meters and conductivity meters can be used.

Access Hatches
Access hatches at the base of the tank allow access during a shut-down of the tank and to fulfil gas freeing of the tank. This is also the access route where any solids left in the tank are removed during cleaning operations. An access hatch is also usually provided for horizontal tanks (both atmospheric and pressurised) on the top of the tank.

Drains
The two drain valves will be provided to enable simultaneous operation of both valves by a single operator. The downstream valve is normally a quick-acting spring loaded type (spring to close) valve that will operate as a dead man's handle. The drain outlet point can be lined up to a vapour treatment (i.e. thermal oxidiser) via a vapour knock out vessel.

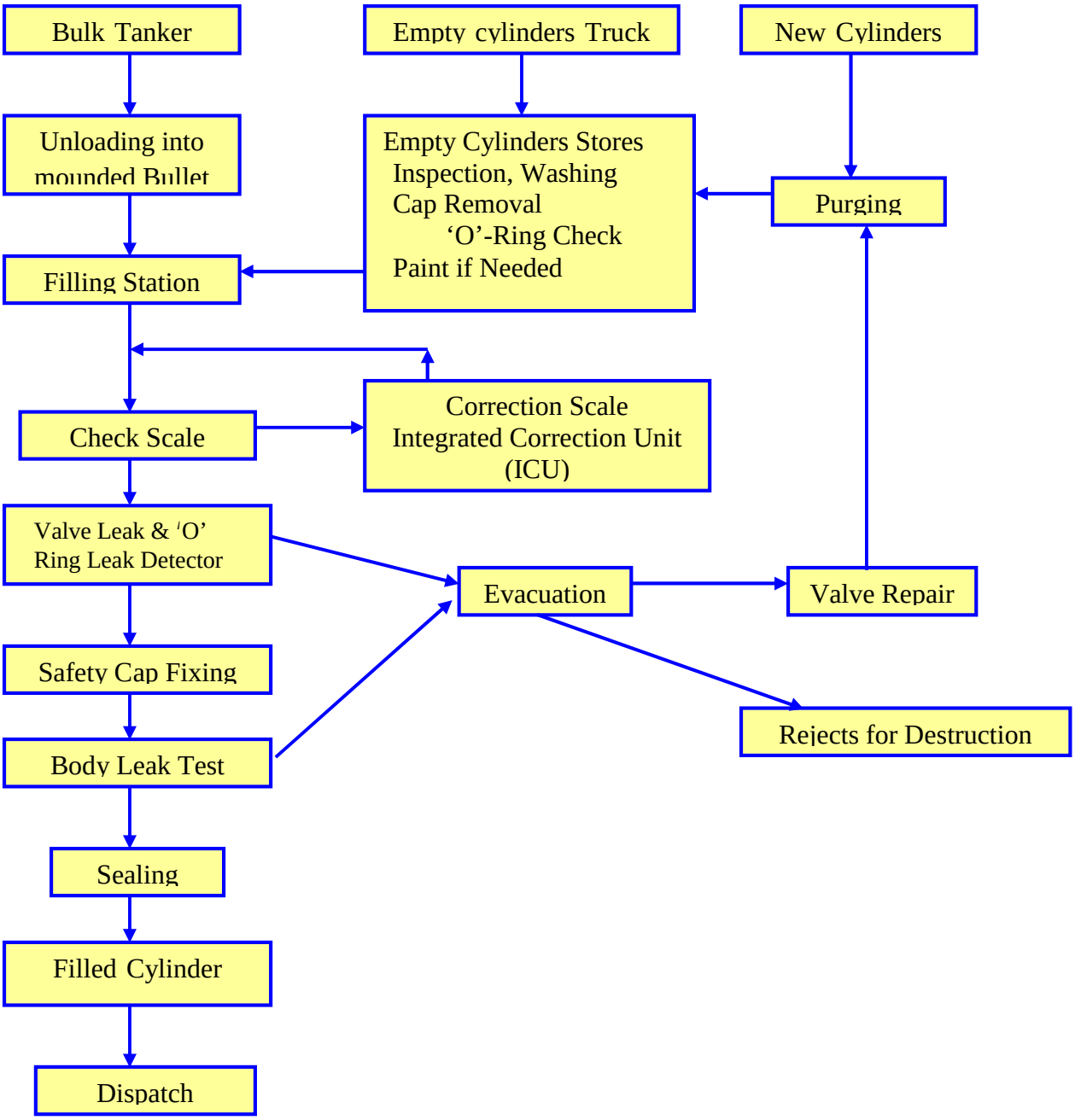
2.7 Process Description

The Process flow chart of the LPG operations is shown in **Figure 2.4** and Piping System and Instrumentation is shown in **Figure 2.5**

The process involved the following steps:

Unloading
LPG from road tankers is unloaded in TLF shed comprising of unloading bays. The road tankers are connected to liquid and vapour lines from storage system by unloading arm provided with excess flow check valve and isolation valve. Road tankers are provided with Roto gauges. Flow indicators are provided in the liquid line leading to Bullets. Vapour line is connected to the compressor through a four way valve. LPG is unloaded from the road tanker by differential pressure method. During LPG unloading, vapour from one storage bullet is sucked and is compressed in LPG compressor. The compressed LPG vapour is fed to bulk tanker to pressurize it and LPG (Liquid) is transferred from the road tanker to the Bullet.

After LPG unloading, the compressor suction is reversed by changing the valve position and LPG vapour is recovered from road tanker through the same compressor and discharged to storage system till the suction pressure of compressor falls from an initial value of 11.6 Kg/cm^2 to 2 Kg/cm^2.


Bulk Tanker
Empty cylinders Truck
New Cylinders
Unloading into mounded Bullet
Empty Cylinders Stores
Inspection, Washing
Cap Removal
'O'-Ring Check
Paint if Needed
Purging
Filling Station
Check Scale
Correction Scale
Integrated Correction Unit
(ICU)
Valve Leak & 'O' Ring Leak Detector
Evacuation
Valve Repair
Safety Cap Fixing
Rejects for Destruction
Body Leak Test
Sealing
Filled Cylinder
Dispatch

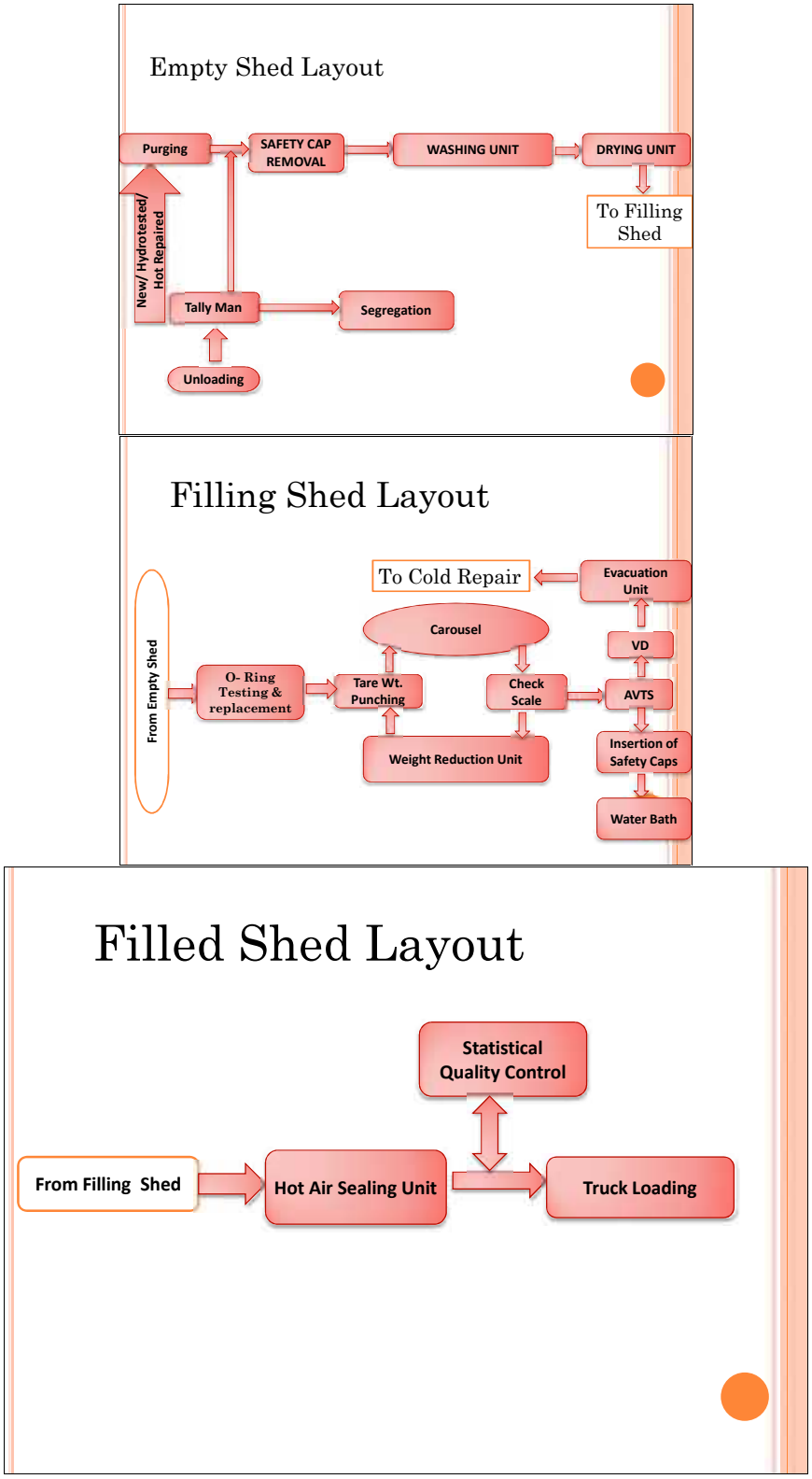


Figure 2.4: Process Flow Chart

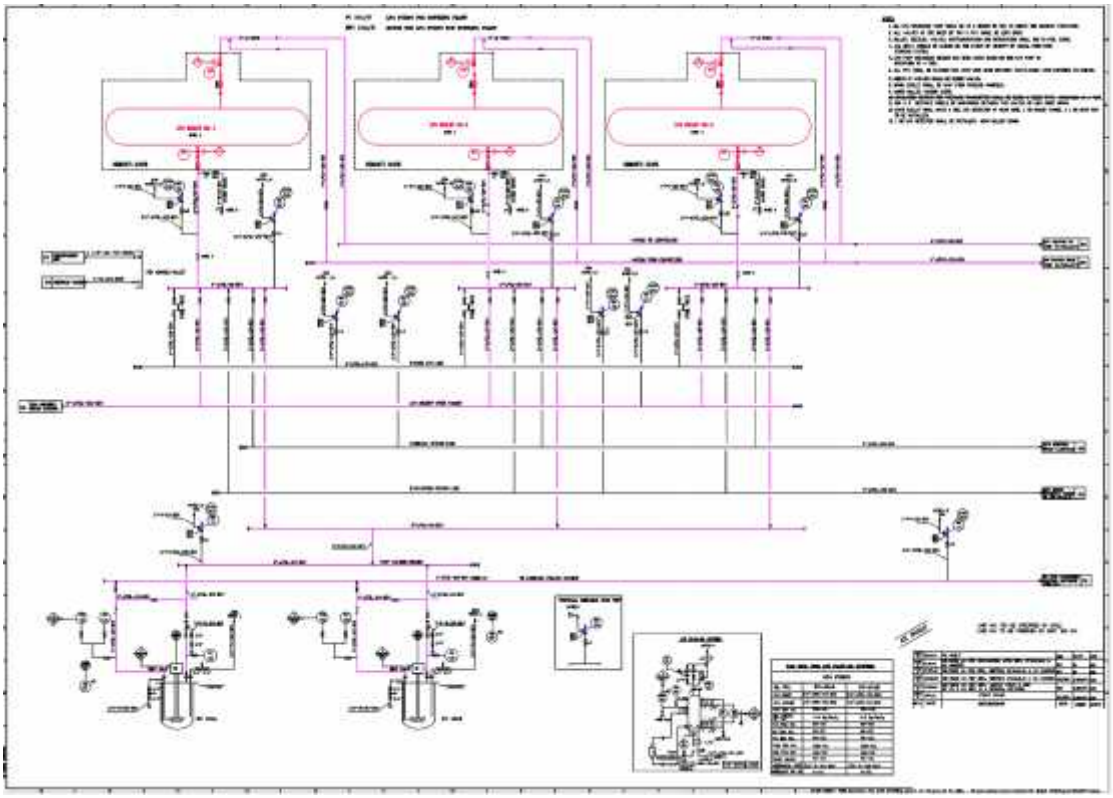


Figure 2.5: Piping System and Instrumentation

LPG Pumps and Compressor House

LPG pumps will take suction from bottom of Mounded Bullets and deliver liquid to carousal for filling in empty cylinders. Two verticak can type pumps have been installed to pump liquid LPG from storage vessels to carousel. These pumps have been provided with pop action valves on discharge lines and are coupled to flame proof motors.

Four LPG vapour compressors each coupled to a flame-proof motor have been installed for loading/unloading of LPG based differential pressure mechanism. The maximum discharge pressure of these compressors is 17.0 kg/cm^{2}g. Details of LPG pumps and Compressor house are given in **Table 2.5**.

Table 2.5: Pumps at the LPG BP, Salem

Pump Capacity (m^3/hr)	Pump Type	Motor Rating, KW	Purpose (Bottling/TT Loading)	Line Size, inches	
				Suction	Discharge
85	Vertical can	37	Bottling	4’	4’

LPG Vapour Compressors

4 nos. of LPG vapour compressors have been provided for unloading of LPG from road tankers by pressurization and thereafter for recovery of LPG vapour from the road tankers when unloading is complete

Air Compressor & Air Drying Unit
Three nos. of non-lubricated screw type Air compressor are provided for supply of compressed air for plant requirement as well as for instrument air at a pressure of 8 Kg/Cm^2a. The air compressor and air drying unit are located away from LPG handling facilities.

LPG Cylinder filling and associated facilities
Types of cylinders used are 14.2 Kg, 19Kg. However in future both 47.5 Kg and 5 Kg cylinders would also be used. Empty cylinders from storage shed are sent to filling shed by chain conveyer. LPG is filled by means of rotary machines (Carousel). The speed of the driving unit is variable so that the rotation of the carousel can be adapted to various filling capacities. The machine is preset for the net filling required in the cylinders. The filling machine is adjusted for the respective tare weight of the cylinders and is automatically cut off when the total gross weight reaches.

2X 24 point electronic filling machines and cylinder conveyor chain system have been installed for filling of 14.2 kg and 19 kg cylinders. Besides the above this shed also has electronic check scales for weight checking filled cylinders, weight correction unit machines, Automatic valve testing machines, test bath for checking any leakage from cylinder bung and body. Hot air sealing machine for sealing of cylinders prior to dispatch and RQC machine for quality checks of cylinders facilities are there in the filling shed. Processed cylinders directly go to loading bays and failed cylinders during testing go to repair/servicing.

Checking of weight and Leak testing
After filling, each cylinder is checked for the weight and the cylinders having less or more weight are segregated. The cylinders are checked for valve leakage by Double Compaction Valve Testing (DCVT) and then checking for body and bung leaks by totally submerging cylinders under water. Finally the cylinders are sent to filled cylinder storage via chain conveyers for loading in the trucks.

Evacuation of leaky cylinders
LPG is taken out from leaky cylinders and defective valve is replaced in the repairing shed. This unit consists of one LPG vapour compressor, two evacuation vessels and cylinder stand to keep the leaky cylinders in inverted position. Transfer of LPG from leaky cylinders is done by differential pressure method. The liquid collected in a vessel is transferred to vessels by pressurization. Leaky cylinders are further evacuated and thereafter depressurized through cold flare unit before sending for cold repair.

Storage of filled cylinders & transportation
Filled cylinders are stacked in the filled cylinder shed near the delivery end as per rules laid down by OISD/Gas Cylinder Rules, 1981. Filled cylinders are delivered only to the authorized LPG distributors. Drivers of the trucks carrying LPG are having valid license and are having training in safety & fire fighting procedures.

Transport and handling through piping system, handling techniques, specific equipment used and standard operating procedures etc. the details are given below:

Receipt of Empty LPG Cylinders
Three Telescopic type unloading bays are provided for unloading of empty cylinders received in trucks at plant. All necessary inspections are carried out after unloading at telescopic conveyor before going for filling. The segregated cylinders are stacked separately and the same undergoes testing/repair.

Dispatch of Filled Cylinders
After passing of all tests, the filled cylinders are loaded in Cylinder trucks by using two Telescopic type loading bays. Packed cylinders are sent to distributors in a truck having capacity of 306/100 cylinders.

2.8 Resources requirement for the Proposed Project

2.8.1 Land use and Land Ownership

The proposed expansion will be carried out in the land of existing plant. Hence, no alternate sites were considered for the project, no change in land use.

The total land in possession of IOCL is about 21.55 acres, out of which proposed project needs 1.5 acres for proposed 3 mounded bullets, stone pitching around the bullets and motor-able road around the mounded bullets and for laying the fire fighting hydrant network around the mound.

2.8.2 Water requirement

Presently pant ids having two open wells and one bore well and also water will be sourced from Municipal Corporation. For the expansion project 25 m^3 /day of water is required for the proposed expansion Salem Bottling Plant operates strictly as a storage & packing facility for LPG. No by-products / additional products are generated / manufactured during the operations. Hence, the present proposal is classified under Schedule 6(b) & Category 'B' according to EIA Notification 2006 & subsequent amendments.

Water for the project will be supplied by Karuppur Panchayat under Omalur Taluka. Breakup of existing and proposed water requirement is given in below **Table 2.6**. Water allocation letter enclosed as **Annexure-IV**

Table 2.6: Water Consumption

Particulars	Quantity (m^3/day) From client	
	Existing	Proposed
Hydraulic testing and washing of cylinders	6	13
Gardening	3	5
Domestic	7	5
Mock drills (once in six months)	2	2
Total	18	25

2.8.3 Power requirement

Plant receives power from Power Grid, with contract load of 275 kVA . Actual requirement of plant is 240kVA. In addition, IOC has stand by DG sets of 400 kVA.

2.9 Proposed Schedule and Approval for Implementation.

The plant activities will be completed in a period of 24 months from the date of receipt of all the approvals from statutory authorities.

2.10 Utilities and Services

2.10.1 Machinery Stores

Adequate storage facilities for machinery spares and other consumables, including an open yard, have been established to meet the requirement of plant.

2.10.2 Workshop

Based on the location of the plant, reasonably good workshop facilities have been established, both for mechanical and electrical equipment repairs and maintenance.

2.10.3 Time Office and Security Office

The time office and security office complex is well established.

2.10.4 Fire Fighting System

For protection system has following:

- Hydrant system;
- High pressure water sprinkler system;
- Foam system;
- Portable fire extinguishers; and
- Mobile high-pressure fire hydrant system.

.

2.10.5 Infrastructure Facilities for Labour Force

The following amenities will be provided to the workers:

- Drinking water facility;
- Sanitation facilities will be constructed which will include the adequate number of separate toilets for men and women. The make shift treatment plant will be installed and treated wastewater will be utilized in greenbelt development;
- Bins will be installed to collect municipal waste

2.10.6 First Aid Room

First aid room of adequate size with required equipment will be established near the office, whereas the first aid station near the workings is of mobile type. Rest shelter of standard design will be provided near the first aid station. Cool and wholesome drinking water will be provided at the shelter in suitable container.

2.11 Sources of Pollution and Built-in Control Measures

2.11.1 General

In the operations, as well as in the auxiliary units, different waste materials will be generated. These waste materials mainly include gaseous emissions, wastewater and solid wastes from the utilities:

- The emissions include the dust due to vehicular movement;
- The main atmospheric pollutant is fugitive emissions;
- The water in the plant is mainly used for domestic purpose and no process wastewater is generated
- The solid waste in the form of sludge is mainly generated will be used as manure

The various types of pollution from the proposed expansion project are categorized under the following types:

- Air pollution;
- Water pollution;
- Pollution emanating due to solid waste; and
- Noise pollution

2.11.2 Air Pollution

The following are the potential emission sources while handling the liquid and liquefied gas storage and handling area:

- Filling;
- Cleaning;
- Pigging;
- Purging;
- Sampling
- Disconnecting;
- Opening;
- Pressure relief;
- Fugitive; and
- Emptying/draining.

Fugitive emissions of VOCs are the major sources of air pollution in storage facilities and from static and dynamic joints and seals used in flanges, pumps, mixers, valve packing and connection joints. In order to minimize the fugitive emissions of VOCs, the following measures are incorporated at design stage:

- Minimum number of flanges, valves etc;
- Provision of leak proof valves like ROV/Gate Valves/Quick Shut-Off valves;
- High grade gasket materials
- Usage of pumps with (single/double) mechanical seals

2.11.3 Wastewater Generation

Sewage generation is envisaged during operation phase and existing soak pit will be adequate to cater the sewage load. Sewage from the administration building will be routed to the septic tanks followed by soak pits and the sludge generated from the septic tank will be dried and used as manure for green belt area.

2.11.4 Solid Waste / Sub-Grade Material

No process / manufacturing involved. Hence no solid waste generated.

2.11.5 Noise Levels and Vibration

The DG sets shall be acoustically insulated resulting in reduction of noise as per limits prescribed by Central Pollution Control Board. The exhaust pipe from DG sets shall be taken above the building as per Central Pollution Control norms.

2.11.6 Source of potential Air and Water Emission sources

The details of possible emission sources are given in **Table 2.7**.

Table 2.7: Potential Emission Sources from Bottling Plant

Sr. No	Type of Storage	Potential Emissions to Air	Potential Emissions to Water
1	Mounded storage (pressurised)	Filling, breathing, emptying, cleaning, blanketing, manual gauging, sampling, fugitive, draining	Draining, cleaning, sampling
Apart from operational losses, infrequent emissions also occur from incidents and (major) accidents such as leakages may occur			

CHAPTER 3. DESCRIPTION OF THE ENVIRONMENT

3.1 General

This chapter provides the description of the existing environmental status of the study area with reference to the environmental attributes like air, water, noise, soil, land use, ecology, socio economics, etc. The study area covers 10 km radius around the project site.
The existing environmental setting is considered to adjudge the baseline conditions which are described with respect to climate, atmospheric conditions, water quality, soil quality, ecology, socioeconomic profile, land use and places of archaeological importance.

3.2 Methodology

The methodology for conducting the baseline environmental survey obtained from the guidelines given in the EIA Manual of the MoEF&CC. Baseline information with respect to air, noise, water and land quality in the study has eben collected by primary sampling/field studies during the period of **January 2016 to March 2016.**

The meteorological parameters play a vital role in transport and dispersion of pollutants in the atmosphere. The collection and analyses of meteorological data, therefore, is an essential component of environmental impact assessment studies. The long term and short term impact assessment could be made through utilization and interpretation of meteorological data collected over long and short periods. Since the meteorological parameters exhibit significant variation in time and space, meaningful interpretation can only be done through a careful analysis of reliable data collected very close to the site.

3.3 Study Area included in Environmental Setting

The study area is considered to be area within a radius of 10 km of the IOCL plant boundary. The EIA guidelines of the MoEF mandate the study area in this manner for EIA's.

3.3.1 Land Use/Land Cover of the Study Area

Land Use Land Cover studies are conducted using satellite imagery. The details of satellite image are as follows:

Satellite Data: Landsat 8 cloud free data has been used for Landuse / landcover analysis.
Satellite Sensor – OLI_TIRS
Path and Row – Path 142, Row 52
Resolutions – Panchromatic 15 m Reflective 30 m
Date of Pass: 10th February 2016
Ancillary Data: GIS and image-processing software are used to classify the image and for delineating drainage and other features in the study area.

The study area of 10km radius from the centre of project site shows sevendifferent land use classes. Agriculture land (23.86%) along with fallow land (38.71%) dominatesthe land use pattern covering 10km surrounding the project site. Since the project site is located in the vicinity of Salem city, built-up area comprises of 10.64% landuse. Open land 13.16% and

scrub land (10.34%) constitutes majority of landuse. Vegetation (2.83%) located in the north east of 10 km radius and water bodies (0.45%) spread throughout the study area form landuse classes present in the study area. The LULC classes are identified and presented in **Table 3.1 and Figure 3.1**.

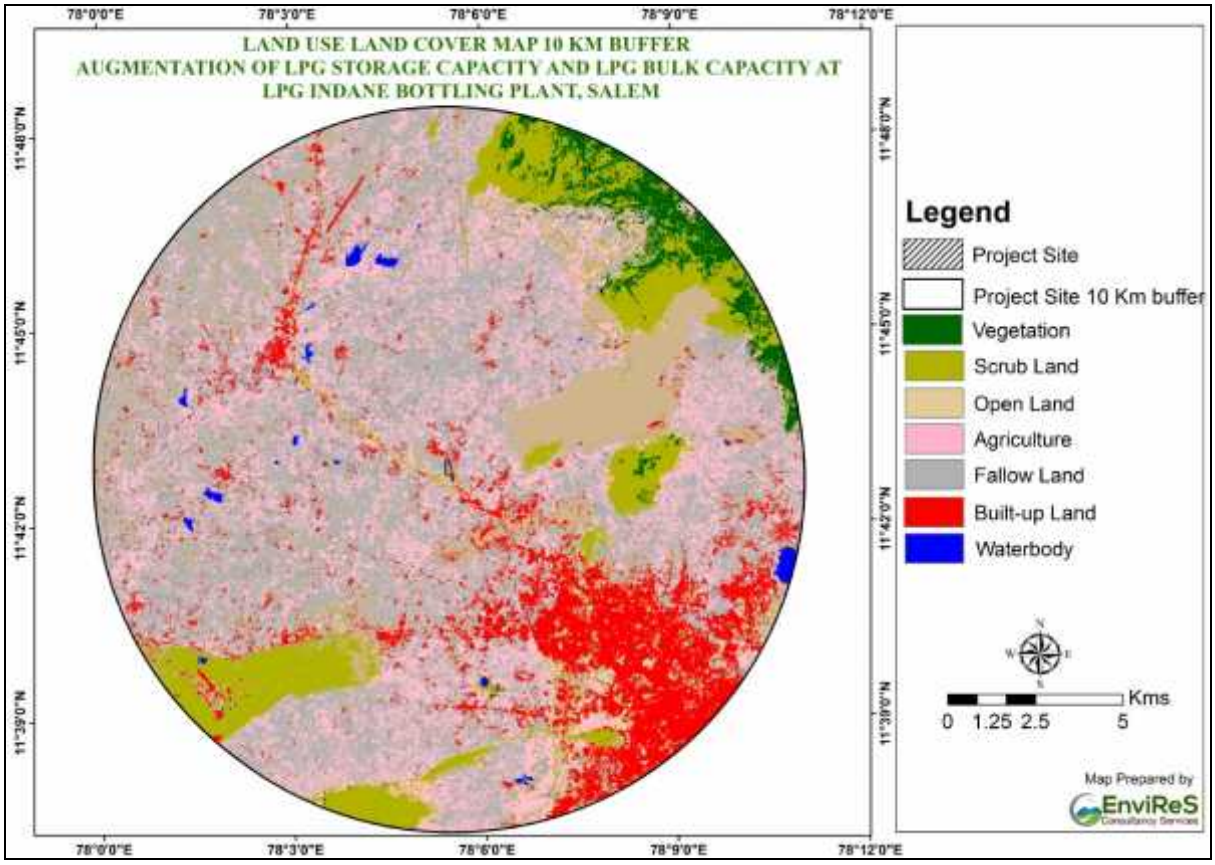


Figure 3.1: Landuse/Landcover of 10 Km Study Area

LULC Class	Area(Sq.Km)	%
Vegetation	9.34	2.83
Scrub Land	34.11	10.34
Open Land	43.40	13.16
Agriculture	78.68	23.86
Fallow Land	127.66	38.71
Settlement	35.09	10.64
Waterbody	1.49	0.45
Total	**329.76**	**100.00**

Table 3.1: Landuse / Landcover Statistics of Area within 10 km Radius

Open land (26.04%) and Scrub land (34.15%) dominate the landuse pattern covering 500 m angular distance around project site. Agriculture land (11.40%) and Fallow land (7.84%) indicate availability of irrigation in the surround area. Settlementdominates the land use pattern in the study area covering 500 m angular distance around the project site. It covers 19.40% of the total study area. Waterbody constitutes merely 1.18% of the landuse. The LULC classes are identified and presented in **Table 3.2 and Figure 3.2**.

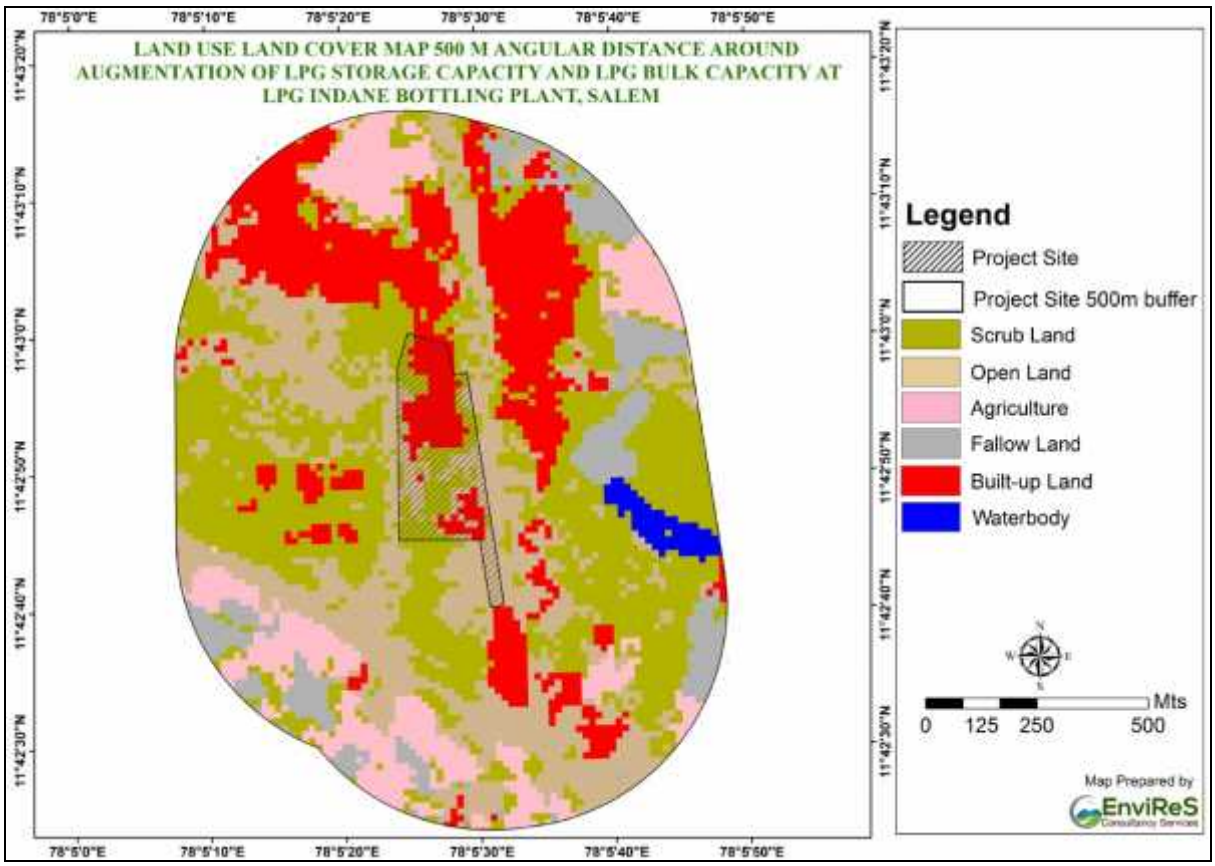


Figure 3.2: Landuse/Landcover of 500 m Buffer Area

LULC Class	Area(Sq. km)	%
Scrub Land	0.56	34.15
Open Land	0.43	26.04
Agriculture	0.19	11.40
Fallow Land	0.13	7.84
Settlement	0.32	19.40
Waterbody	0.02	1.18
Total Area	**1.64**	**100.00**

Table 3.2: Landuse / Landcover Statistics of Area within 500m Buffer Area

3.3.2 Drainage Map of the Study Area

Drainage layer, which was generated after scanning the thematic manuscripts, was edited for line the errors. Two different layers were made separately for line drainage. Drainage order was given to all the drain lines in the layer's. Strahler method of ordering was used for giving order to drainage. Whenever two drains of any order joined the order of next drain was increase by one.

The study area exhibits majority of third order of drainage of drainage pattern.SarabangaRiver flows towards west from North West.East Sarabanga and West Sarabanga Rivers merge together near Omalur.ThirumanimutharRiverAll Rivers with sufficient width were put in polygon layer. Drainage pattern within 10 km radius around project site shows the dendritic type of drainage pattern of third order and majority of streams flow towards south and west side. The 10 km area around project site exhibit a number of smaller lakessuch as Kannankurichi lake, Nembala lake, Pallapatti lake, SelatthampattiYeri lake, and two lakes near Salem Airport.

The area shows not much of undulating topography. The area covering 500 m angular distance around project site shows drainage lines passing away from Project site. No natural drainage lines pass through the project site.

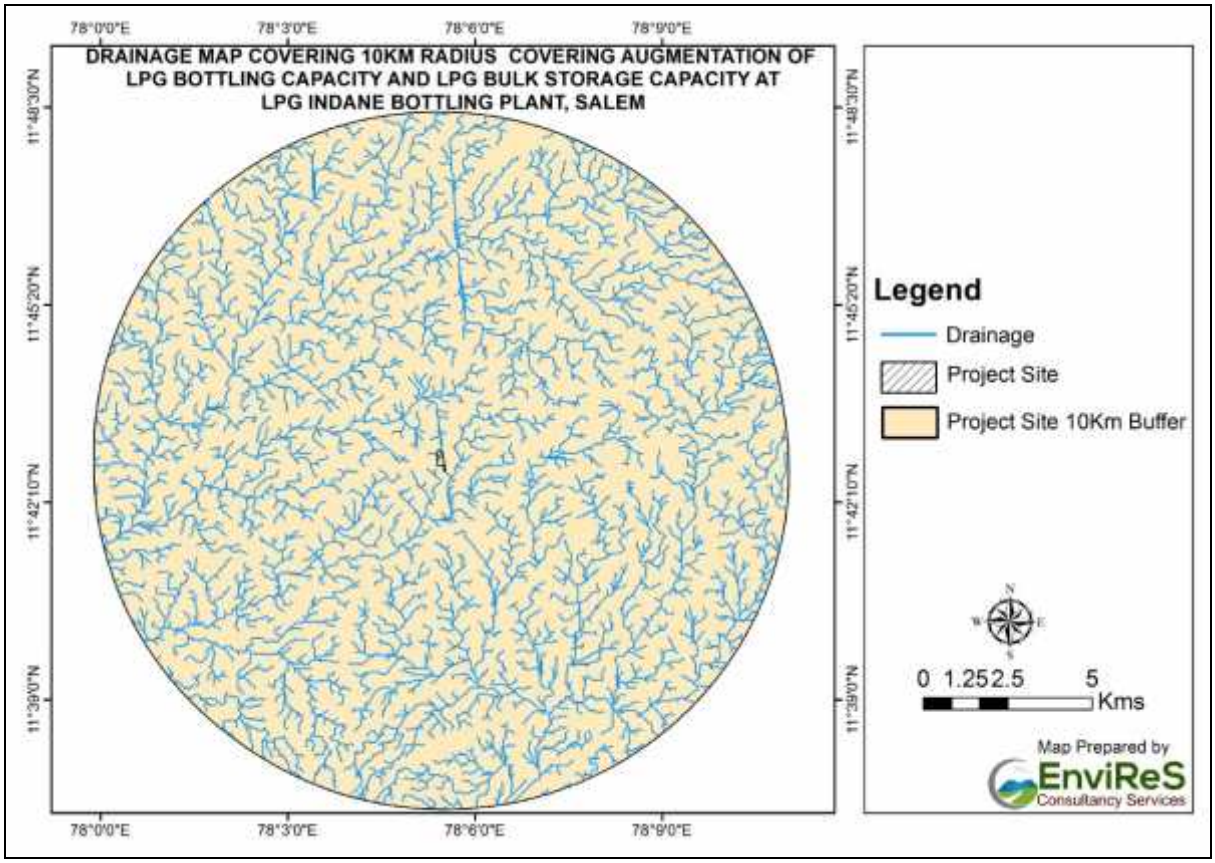


Figure 3.3: Drainage Pattern of 10 Km Study Area

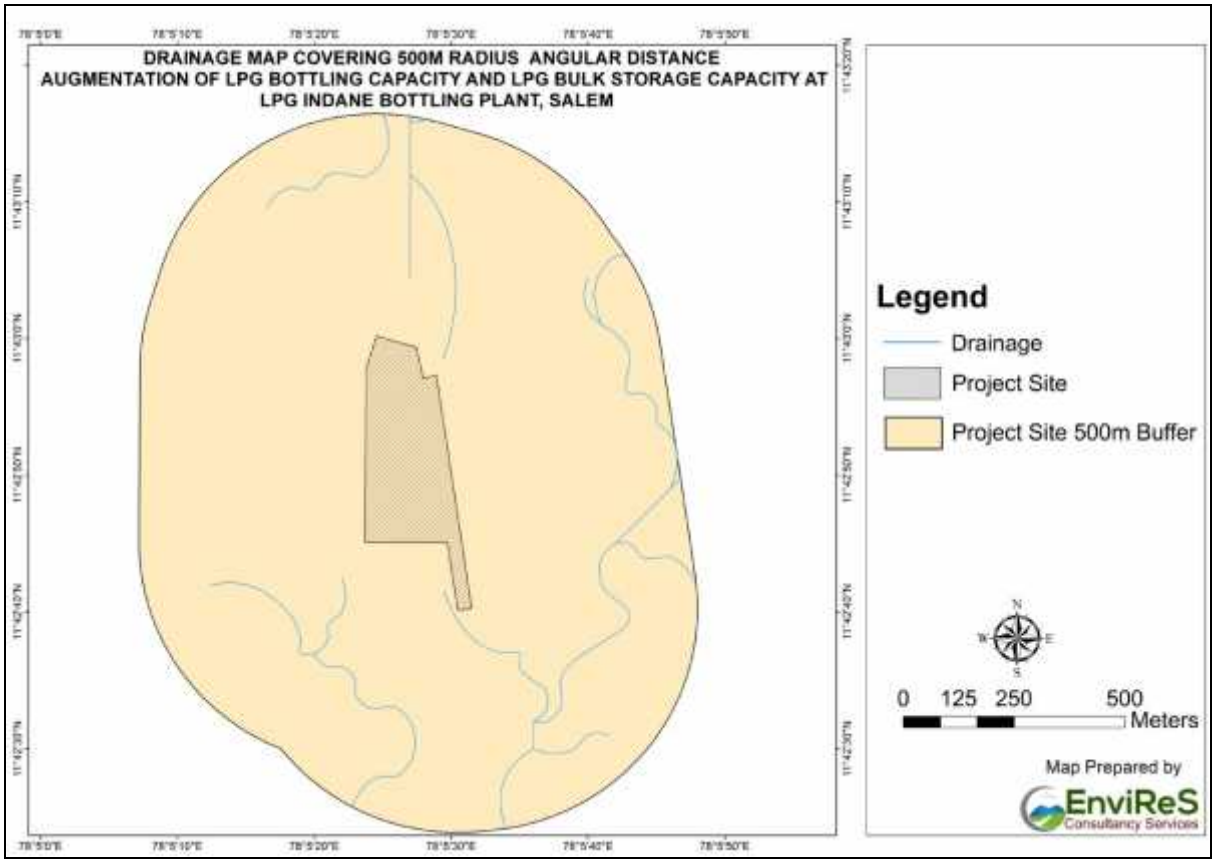


Figure 3.4: Drainage Pattern of 500 m Buffer Area

3.3.3 Contour Pattern of the Study Area

Thematic manuscript for contour layer was generated from Digital Elevation Model (DEM). After scanning, coverage was generated. Coverage was edited to remove all errors of dangle. Attribute value was given to each contour in the coverage.

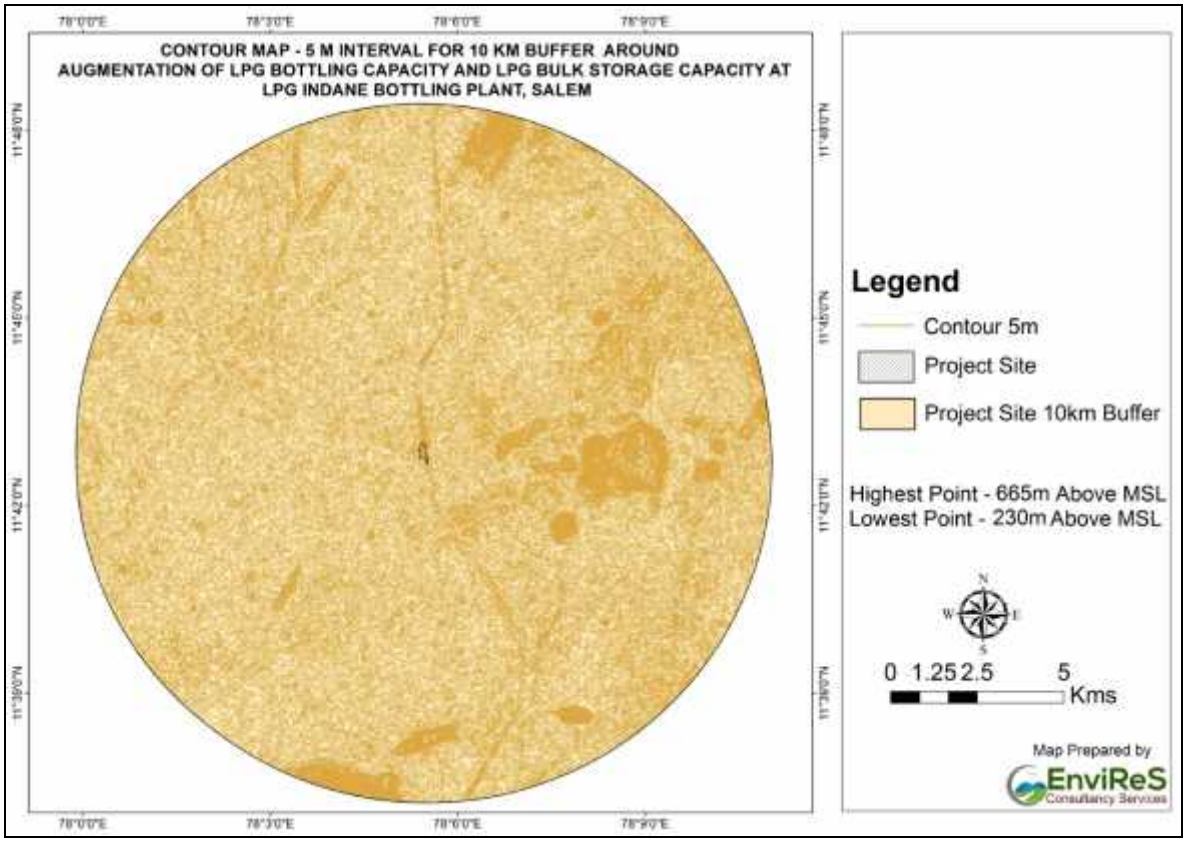


Figure 3.5: Contour Pattern of 10 Km Study Area

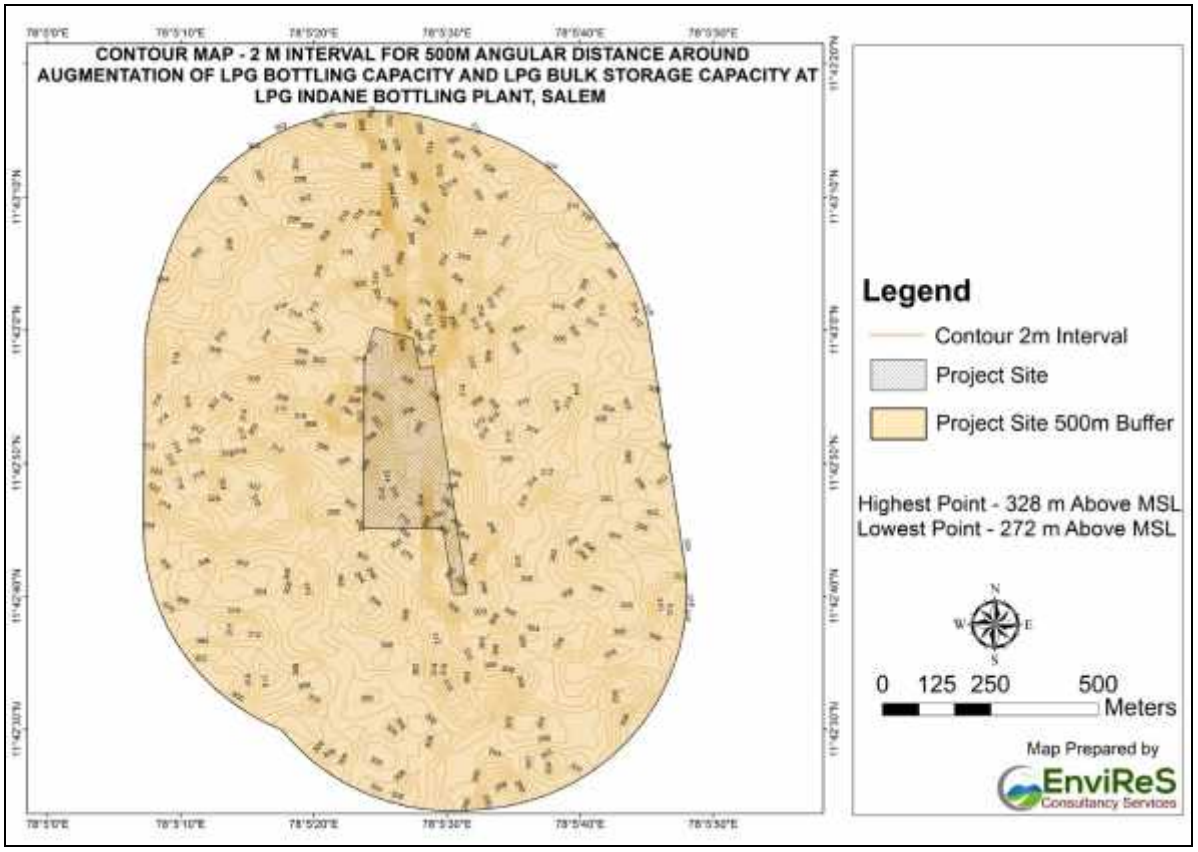


Figure 3.6: Contour Pattern of 500 m Buffer Area

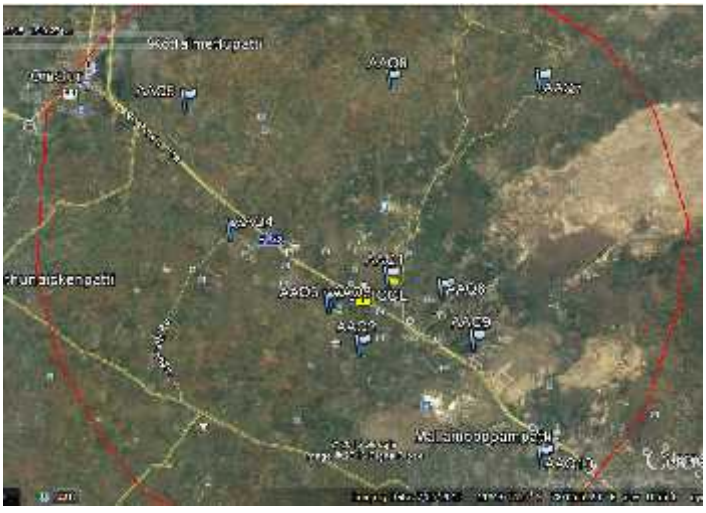
Contour map of 10 km radius around project site shows predominant mountain ranges towards extreme North and South project site. Hilly terrain is also visible in the west side of project site. The project site is located between Southern railways KaruppurStaion and National Highway 7 or Asian Highway 43. The overall topography within the 10 km radius around project site is not very undulating. Highest point of the area covering 10 km radius around project site is 665 m whereas the lowest point is less than230m above mean sea level.

500 m angular distance around project site shows comparatively flat terrain with minor undulations around project site. Overall expanse of the contours is gradual and do not show steep slopes.The project site shows slope towards east. Highest point of the area covering 500 m angular distance around project site is 328 m located at the southernmost side whereas the lowest point is at 272 m.

3.4 Meteorological Data

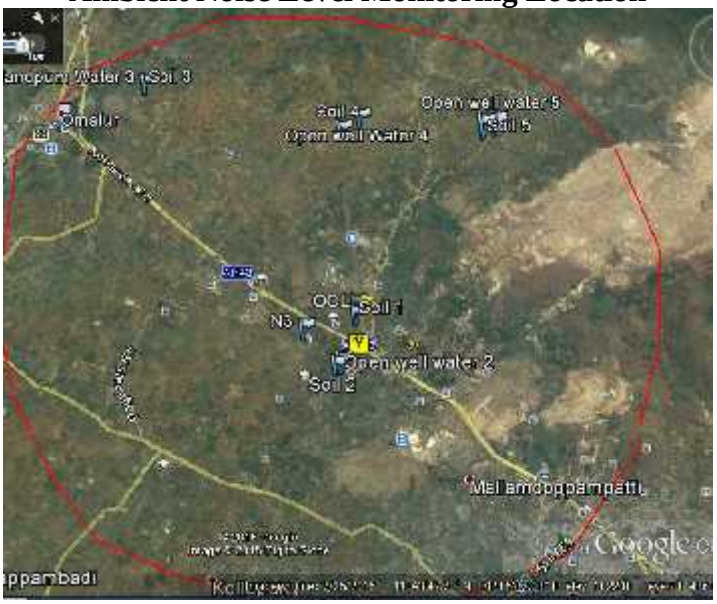
During study, a continuous automatic weather monitoring station was established at site to record wind speed, wind direction, relative humidity and temperature. Atmospheric pressure was recorded twice a day at **08.30 and 17.30 hrs**. Cumulative rainfall was monitored by rain gauge on daily basis. This station was in operation in study period.

The methodology adopted for monitoring meteorological observations is as per the standard norms laid down by Bureau of Indian Standards and the India Meteorological Department (IMD). Hourly maximum, minimum and average values of wind speed, direction and temperature are recorded continuously at site.
The 10 km study area inclusive of all the monitoring locations has been as shown in **Figure 3.7**.



Ambient Air Quality Monitoring Location

Ambient Noise Level Monitoring Location



Water & Soil Sampling Location

Figure 3.7: Baseline Sampling Monitoring Locations

A fully instrumented continuous recording meteorological observatory is established and operated at project site during study period The parameters are being monitored at site is given in **Table 3.3**.

Table 3.3: Meteorological Monitoring At Site

S.N.	Parameter	Instrument	Frequency
1	Wind Speed	Automatic Weather station (Envirotech WM 251)	Continuous Automatic 1 hourly Average
2	Wind Direction		
3	Ambient Temperature		
4	Max. & Min	Wet & Dry Bulb	Daily at 08:30 and 17:30

	Temperature	Thermometer	IST
5	Relative Humidity	Hygrometer	Daily at 08:30 and 17:30 IST
6	Rainfall	Rain Gauge	Daily

The aforesaid meteorological parameters were being observed in the field during monitoring period. The analysis of the field observations is given in **Table 3.4**. The wind rose during the study period is presented in **Figure 3.4.**

Table 3.4: Meteorological Data Recorded at Site

Month	Temperature, °C		Relative Humidity, %		Wind Speed, m/s	Predominant wind direction
	Min	Max	Min	Max	Mean	
January to March 2016	17.0	29.8	27	82	2.20	SE

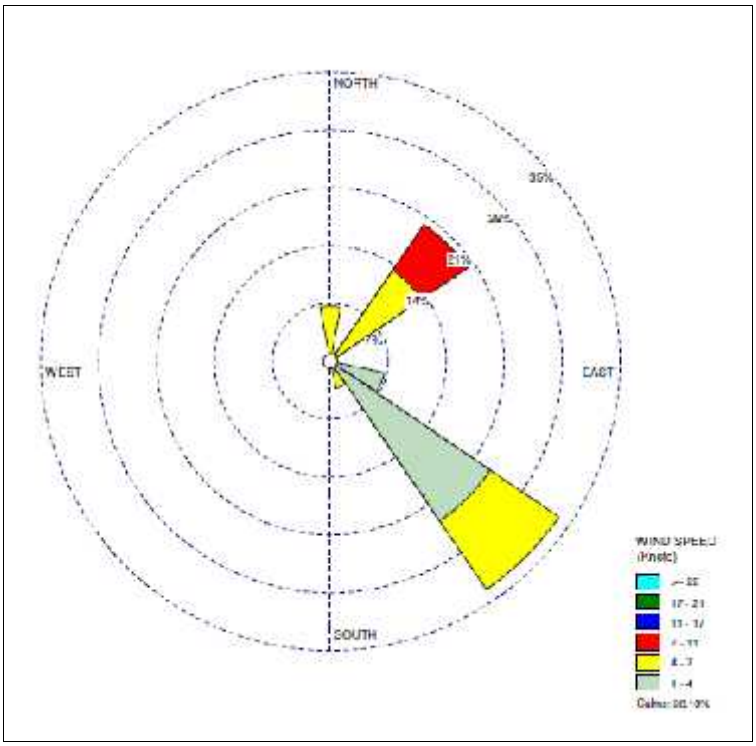


Figure 3.4a: Windrose for period January 2016

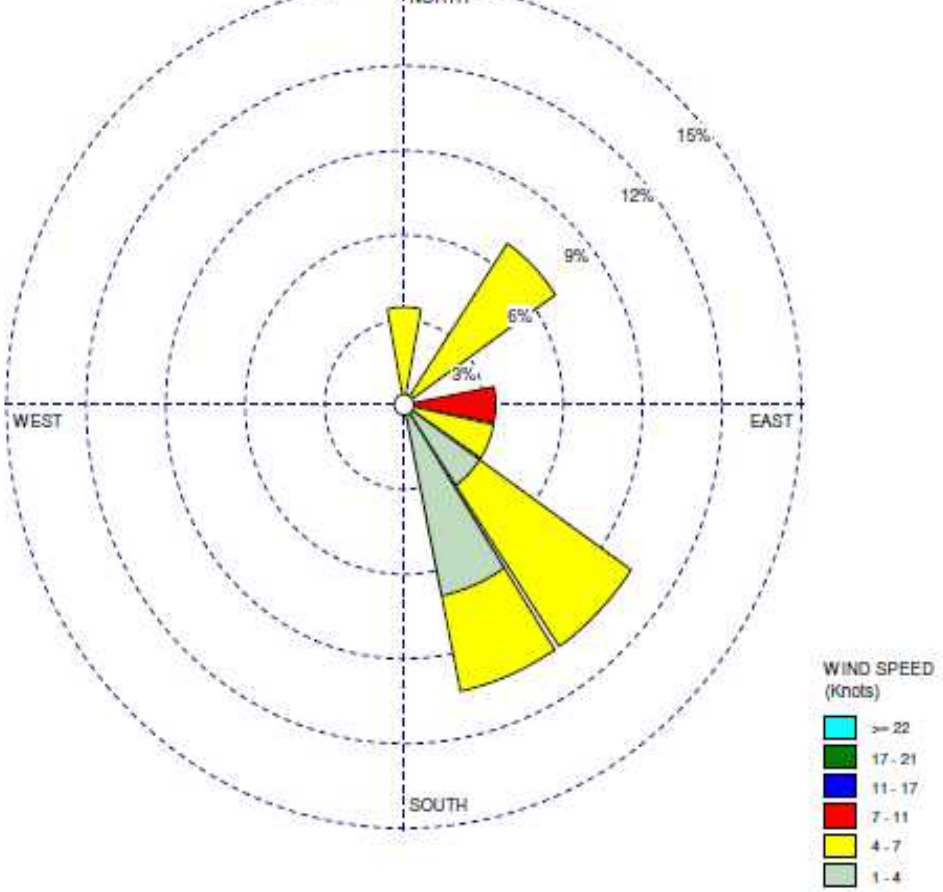


Figure 3.4b: Windrose for period February 2016

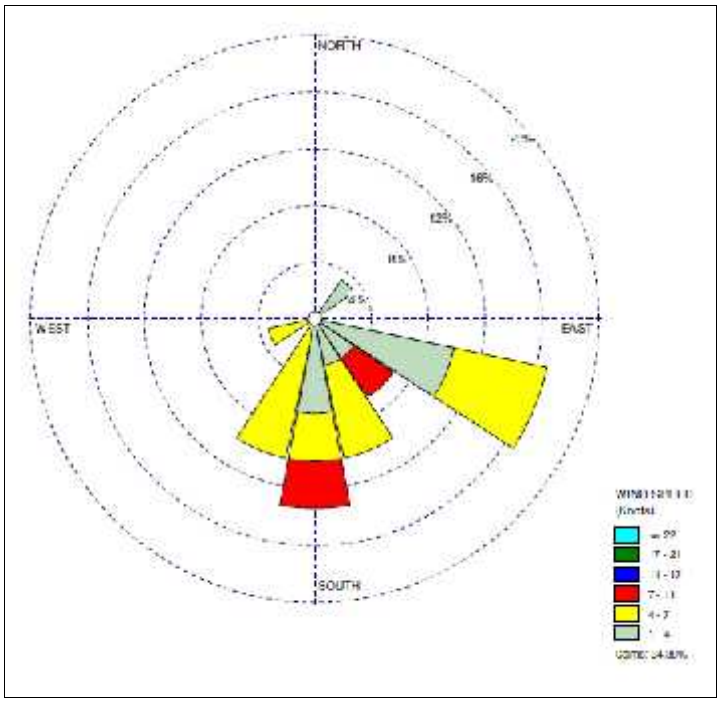


Figure 3.4c: Windrose for period March 2016

Figure 3.4: Windrose for period of January 2016 to March 2016.

3.5 Ambient Air Quality

The ambient air quality monitoring was carried out at ten locations within the 10 km radius around the site of project to know the existing background ambient air quality. The purpose of the estimation of background pollutant concentration was to assess the impact of the project on the ambient air quality within the region based on the activities of the project. The parameters chosen for assessment of air quality were PM_{10}, $PM_{2.5}$, Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx), Hydrocarbon (Methane and Non-methane HC) and VOCs.

3.5.1 Methodology Adopted for the Study

$PM_{10,}$ $PM_{2.5,}$ Sulphur dioxide (SO_2), Oxides of Nitrogen (NOx), Hydrocarbon (Methane and Non-methane HC) and VOCs were the major pollutants associated with project. The baseline status of the ambient air quality has been established through field monitoring data on PM_{10}, $PM_{2.5,}$ Sulphur dioxide (SO_2), oxides of nitrogen (NOx), Hydrocarbon (HC) Methane and Non-methane HC) and VOCs at 10 locations within the study area. The locations for air quality monitoring were scientifically selected based on the following considerations using climatological data.

- Meteorological conditions on synoptic scale;
- Topography of the study area;
- Representative ness of the region for establishing baseline status; and
- Representative ness with respect to likely impact areas.

Ambient air quality monitoring was carried out on 24 hour basis with a frequency of twice a week at a station during the study period for 10 locations.

The location of the monitoring stations with reference to the project site is given in **Table 3.4**.

Table 3.4: Ambient Air Monitoring Locations

SN	Location	Location Code
1	Main gate – IOCL Salem	A1
2	Saminaickenpatty Village	A2
3	Anaigoundampatty Village	A3
4	Kotta goundampatti village	A4
5	Mottupatty Village	A5
6	Porasamarathukadu Village	A6
7	Indra Nagar	A7
8	Moongilpadi village	A8
9	Vellakalpatti Village	A9
10	Reddipatti - Mamamgam	A10

3.5.2 Sampling and Analytical Techniques

Respirable Dust Samplers APM-451 of Envirotech instruments were used for monitoring Respirable fraction (<10 microns) and gaseous pollutants like SO_2, NOx, Methane and Non-methane (HC) and VOCs. **Table 3.5** shows the techniques for sampling and analysis for these parameters.

Table 3.5: Techniques Used For Ambient Air Quality Monitoring

Parameters	**Technique**	**Technical Protocol**	**Detectable Limit, ug/m^3**
PM_{10}	Respirable Dust Sampler (Gravimetric method)	CPCB Guidelines	10.0
Sulphur Dioxide	West and Gaeke	IS-5182 (Part-II)	5.0
Nitrogen Oxide	Jacob & Hochheiser	IS-5182 (Part-VI)	5.0
Hydrocarbon (Methane and Non-Methane)	Gas Chromatograph (FID Detector)	Is-5182 (Part-XXI)	0.1 ppb
VOCs	Activated Charcoal method (GC FID Detector)	EPA TO-17	1 mg/m^3

Ambient air at the monitoring location is sucked through a cyclone. Coarse and non-respirable dust is separated from the air stream by centrifugal forces acting on the solid particles and these particles fall through the cyclone's conical hopper and get collected in the sampling cap placed at the bottom. The fine dust (<10 microns) forming the PM_{10} passes the cyclone and is retained on the filter paper. A tapping is provided on the suction side of the blower to provide suction for sampling air through a set of impingers for containing absorbing solutions for SO_2 and NOx. Samples of gases are drawn at a flow rate of 0.2 liters per minute.

PM_{10} has been estimated by gravimetric method. Modified West and Gaeke method (IS-5182 part-II, 1969) has been adopted for estimation of SO_2 and Jacobs-Hochheiser method (IS-5182 part-VI, 1975) has been adopted for the estimation of NOx. Calibration charts have been prepared for all gaseous pollutants.

The ambient air quality results are as summarised in **Table 3.6.**

Table 3.5: Ambient Air Quality Monitoring Results

PM_{10} (µg/m^3)										
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**
Min	51.9	45.6	40.6	40.3	34.5	35.1	39.6	30.5	33.4	33.8
Max	66.8	54.3	48.5	45.7	46.1	41.6	46.1	43.8	45.9	40.6
Mean	59.35	49.95	44.55	43	40.3	38.35	42.85	37.15	39.65	37.2
Standard	100	100	100	100	100	100	100	100	100	100
$PM_{2.5}$ (µg/m^3)										
Min	20.2	19.8	15.2	15.3	15.2	15.4	15.2	15.4	15.7	15.6
Max	31.9	28.6	23.6	21.6	26.5	21.3	21.6	23.8	23.5	24.7
Mean	26.05	24.2	19.4	18.45	20.85	18.35	18.4	19.6	19.6	20.15
Standard	60	60	60	60	60	60	60	60	60	60
SO_2 (µg/m^3)										
Min	5.3	5.1	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Max	16.2	8.4	6.3	5.1	6.4	5.2	4.8	7.6	10.9	6.1
Mean	10.75	6.75	5.4	4.8	5.45	4.85	4.65	6.05	7.7	5.3
Standard	80	80	80	80	80	80	80	80	80	80
NO_x (µg/m^3)										
Min	15.3	13.7	18.3	14.1	15.3	15.3	16.5	11.1	10.2	13.2
Max	25.1	19.2	27.3	26.1	28.6	24.2	22.7	20.9	18.2	18.5
Mean	20.2	16.45	22.8	20.1	21.95	19.75	19.6	16	14.2	15.85
Standard	80	80	80	80	80	80	80	80	80	80

3.6 Noise

Noise in general is sound, which is composed of many frequency components of various loudness distributed over the audible frequency range. The most common and universally accepted scale is the A weighted scale which is measured as dB (A). This is more suitable for audible range of 20 to 20,000 Hz and has been designed to weigh various components of noise according to the response of a human ear.The environmental assessment of noise from the industrial activity, construction activity and vehicular traffic can be undertaken by taking into consideration various factors like potential damage to hearing, physiological responses, and annoyance and general community responses.

3.6.1 Objective

The main objective of monitoring of ambient noise levels was to establish the baseline noise levels in different zones. i.e. Residential, Industrial, Commercial and Silence zones, in the surrounding areas and to assess the total noise level in the environment of the study area.

3.6.2 Methodology

- **Identification of Sampling Locations**

A preliminary reconnaissance survey was undertaken to identify the major noise sources in the area. The sampling location in the area was identified considering location of industry, commercial shopping complex activities, residential areas with various traffic activity and sensitive areas like hospital, court, temple and schools also near the railway track for railway noise.

The noise monitoring was conducted at eight locations in the study area during monitoring period. 10 sampling locations were selected for the sampling of noise.

- **Equivalent sound pressure level (Leq)**

The sound from noise source often fluctuates widely during a given period of time. Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same time period.

- **Instrument used for Monitoring**

Noise levels were measured using an Integrating sound level meter manufactured by Cygnet (Model No. 2031). It had an indicating mode of Lp and Leq. Keeping the mode in Lp for few minutes and setting the corresponding range and the weighting network in "A" weighing set the sound level meter was run for one hour time and Leq was measured at all locations.

There are different types of fields for measuring the ambient noise level, e categorized as free field, near field and far field.

- **Free Field**

The free field is defined as a region where sound wave propagates without obstruction from source to the receiver. In such case, the inverse square law can be applied so that the sound pressure level decreases by 6dB (A) as the distance is doubled.

- **Near Field**

The near field is defined as that region close to the source where the inverse square law does not apply. Usually this region is located within a few wavelengths from the source.

- **Far Field**

The far field is defined as that region which is at a distance of more than 1-meter from the source.

Table 3.7: Noise Level Monitoring Stations in the Study Area

Sl. No	Location	Location Code
1	Main gate – IOCL Salem	N1
2	Near Govt. Primary School -Saminaickenpatty Village	N2
3	Near Sembumariyamman temple - Anaigoundampatty Village	N3
4	Near Govt. high school -Kotta goundampatti village	N4
5	Near Govt.middle School - Mottupatty Village	N5

6	Near Panchyat union middle school - Sangeethapatti Village	N6
7	Near Govt.primary School – Moongilpadi Village	N7
8	Near sri sri Radha gokulananda temple – Indra nagar	N8
9	Near Manipal Hospital – Dalmia board	N9
10	Engineer's colony - Mamamgam	N10

3.6.3 Method of Monitoring and Parameters Measured

Noise monitoring was carried out continuously for 24-hours with one hour interval. During each hour parameters like L_{10}, L_{50}, L_{90} and Leq were directly computed by the instrument based on the sound pressure levels. Monitoring was carried out at 'A' weighting and in fast response mode.

The important parameters to be measured are L_{eq}, L_{day}, and $L_{night.}$

L_{eq}: Latest noise monitoring equipments have the facility for measurement of L_{eq} directly. However, L_{eq} can also be calculated using the following equation:

$L_{eq\ (hrly)} = L_{50} + (L_{10} - L_{90})^2 / 60$

Where,

L_{10} (Ten Percentile Exceeding Level) is the level of sound exceeding 10% of the total time of measurement.

L_{50} (Fifty Percentile Exceeding Level) is the level of sound exceeding 50% of the total time of measurement.

L_{90} (Ninety Percentile Exceeding Level) is the level of sound exceeding 90% of the total time of measurement.

L_{day}: This represents L_{eq} of daytime. L_{day} is calculated as Logarithmic average using the hourly L_{eq}'s for day time hours from 6.00a.m to 10.00p.m

L_{night}: This represents L_{eq} of night time. L_{night} is calculated as Logarithmic average using the hourly L_{eq}'s for nighttime hours from 10.00p.m to 6.00a.m.

3.6.4 Noise Results

The values of noise level parameters like Leq (day), and Leq (night), were monitored during study period and are presented in **Table 3.8.**

Table 3.8: Ambient Noise Monitoring Results

SN	Villages	Code	Leq (day)	Leq (night)	Remarks
1	Main gate – IOCL Salem	N1	53.7	43.4	Within Limits
2	Near Govt. Primary School -Saminaickenpatty Village	N2	49.7	38.6	Within Limits
3	Near Sembumariyamman temple -	N3	48.8	37.0	Within Limits

	Anaigoundampatty Village				
4	Near Govt. high school - Kotta goundampatti village	N4	48.5	38.8	Within Limits
5	Near Govt.middle School - Mottupatty Village	N5	51.5	41.4	Within Limits
6	Near Panchyat union middle school - Sangeethapatti Village	N6	50.0	39.1	Within Limits
7	Near Govt.primary School – Moongilpadi Village	N7	50.3	39.7	Within Limits
8	Near sri sri Radha gokulananda temple – Indra nagar	N8	50.9	40.2	Within Limits
9	Near Manipal Hospital – Dalmia board	N9	51.9	41.8	Within Limits
10	Engineer's colony - Mamamgam	N10	50.2	39.1	Within Limits

- **Noise Standards**

Ambient air quality standard in respect of noise have been stipulated by Govt. of India vide Gazette notification dated. 14.2.2000. **Table 3.9** describes ambient noise standards.

In Respect of Noise*

Table 3.9: Ambient Noise Standards

Area Code	Category of Area	Limits in dB(A), L_{eq}	
		** Day time	#Night time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone @	50	40

* As per Environment protection act.

** Day Time: 6.00a.m to 10.00p.m.

Night Time: 10.00p.m to 6.00a.m.

@ Silence zone is defined as an area upto 100 meters around such premises ashospitals, educational institutions and courts. The silence zones are to be declared by the competent authority; Use of horns, loudspeakers and bursting of crackers shall be banned in these zones.

The noise data compiled on noise levels is given in **Table 3.8** above**.** Noise level of the study area varied from 48.5 to 53.5 dB (A) in day time and from 37 to 43.4 dB (A) in the night time

3.7 Water Environment

3.7.1 Ground Water Hydrology

Hydro-geologically the weathered and fractured zones of crystalline constitute the predominant hydro-geological units. Groundwater occurs under phreetic condition in the weathered horizons. Highly weathered and jointed granitic gneisses occuring the undulating plains form the potential aquifers in the hard rock terrain. Micaschists and shales having very thick weathered residuum also sometimes form good shallow aquifers to be tapped through dug wells.

The depth of water table in the study area range varies from 11-13 m below ground level during pre-monsoon period and 6-9 m during post-monsoon period.
(Source: http://groundwatertnpwd.org.in/water_level_status.htm).

3.7.2 Selection of Sampling Locations

The assessment of present status of water quality within the study area was conducted by collecting water from ground water sources and surface water sources during Monitoring Period. The sampling locations were identified on the basis of their importance.

Table 3.10: Water Quality Sampling Locations

Station Code	Location
GW1	Open well water – IOCL salem
GW2	Open well water -Saminaickenpatty Village
GW3	Hand pump water - Mottupatty Village
GW4	Open well water-Porasamarathukadu village
GW5	Open well water - Moongilpadi Village

3.7.3 Methodology

Water samples were collected from above sampling locations and analyzed for relevant physical, chemical and bacteriological parameters. Collection and analysis of the samples was carried out as per established standard methods and procedures, prescribed by CPCB, relevant IS Codes and Standard Methods of Examination of Water. (IS 3025 and APHA 22nd ed).
This report presents data for the Monitoring Period.
Analyses of the parameters like temperature; pH, dissolved oxygen and alkalinity were carried out at the sampling stations immediately after collection of samples with the help of Field Analysis Kits. For analysis of other parameters, the samples were preserved and brought to laboratory. The metallic constituents like arsenic, mercury, lead, cadmium, chromium, copper, zinc, selenium, iron and manganese were analyzed with Atomic Absorption Spectroscope.

3.7.4 Water Quality

The analysis data for the monitoring period is presented in **Table 3.11**. The physico-chemical characteristics of Ground water are confirming to permissible limits of drinking water standards, prescribed in IS: 10500 (Test Characteristics for Drinking Water) and suitable for consumption

Table 3.11: Water Quality Results

S.No	Parameter (Characteristic)	GW1	GW2	GW3	GW4	GW5
01	**Turbidity in NTU**	2.0	2.7	1.6	3.2	2.2
02	**Temperature** °C	26.0	25.8	26.2	25.9	26.4
03	**pH @ 25°C**	7.37	7.30	8.18	7.46	8.24
04	**Salinity** g/l	1.03	1.22	0.81	0.72	0.86
05	**Total Dissolved Solids** mg/l	1044	1217	839	980	858
06	**Alkalinity** mg/l	488	472	356	428	384
07	**Total Hardness as $CaCO_3$** mg/l	619	835	403	656	412
08	**Calcium as Ca** mg/l	67	125	17	98	17.4
09	**Magnesium as Mg** mg/l	86	127	88	104	90
10	**Sodium as Na** mg/l	147	137	100	110	101
11	**Potassium as K** mg/l	9.3	14	9.8	11	10.2
12	**Chloride as Cl** mg/l	92	295	90	232	96
13	**Sulphate as SO_4** mg/l	186	139	137	114	148
14	**Nitrate as NO_3** mg/l	BDL (DL:0.5)	BDL (DL:0.5)	BDL (DL:0.5)	BDL (DL:0.5)	BDL (DL:0.5)
15	**Total Nitrogen as N** mg/l	BDL (DL:0.5)	BDL (DL:0.5)	BDL (DL:0.5)	BDL (DL:0.5)	BDL (DL:0.5)
16	**Total Phosphorous as P** mg/l	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
17	**Phenol as C_6H_5OH** mg/l	BDL (DL:1.0)	BDL (DL:1.0)	BDL (DL:1.0)	BDL (DL:1.0)	BDL (DL:1.0)
18	**Dissolved Oxygen** mg/l	5.8	5.5	6.2	6.0	5.7
19	**Chemical Oxygen Demand** mg/l	BDL (DL:4.0)	BDL(DL:4.0)	BDL(DL:4.0)	BDL(DL:4.0)	BDL(DL:4.0)
20	**Bio Chemical Oxygen Demand** mg/l	BDL (DL:2.0)	BDL(DL:2.0)	BDL(DL:2.0)	BDL(DL:2.0)	BDL(DL:2.0)
21	**Fluoride as F** mg/l	0.6	0.63	1.6	0.76	1.8
22	**Iron as Fe** mg/l	0.12	0.12	BDL(DL:0.1)	0.18	BDL(DL:0.1)
23	**Chromium as Cr^{6+}** mg/l	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)
24	**Copper as Cu** mg/l	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)
25	**Manganese as Mn** mg/l	BDL (DL:0.01)	BDL (DL:0.01)	BDL (DL:0.01)	BDL (DL:0.01)	BDL (DL:0.01)
26	**Nickel as Ni** mg/l	BDl (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)	BDL (DL:0.03)
27	**Aluminium as Al** mg/l	BDL (DL:0.02)	BDL (DL:0.02)	BDL (DL:0.02)	BDL (DL:0.02)	BDL (DL:0.02)

28	**Zinc as Zn** mg/l	2.8	3.2	4.2	3.66	3.8
29	**Mercury as Hg** mg/l	BDL (DL:0.0005)	BDL (DL:0.0005)	BDL (DL:0.0005)	BDL (DL:0.0005)	BDL (DL:0.0005)
30	**Arsenic as As** mg/l	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)
31	**Lead as Pb** mg/l	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)
33	**Cadmium in mg/l** mg/l	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)	BDL (DL:0.005)

3.8 Soil

Soil is generally differentiated into two horizons of minerals and organic constituents of variable depth, which differ from the parent material below in morphology, physical properties, constituents, chemical properties, and composition and biological characteristics.
The physico- chemical characteristics of soil have been determined at 3 locations during the monitoring period with respect to colour, texture, cation exchange capacity, pH, N, P, and K etc. The sampling locations have been selected to represent the study area.

3.8.1 Selection of sampling Locations

The soil sampling locations were identified primarily based on the local distribution of vegetation and the agricultural practices. The sampling locations were mainly selected from agricultural field and project site. The sampling locations are given in **Table 3.12** and presented in **Figure 3.7**.

Table 3.12: Soil Sampling Stations in the Study Area

Code	Locations
S1	Soil – IOCL salem
S2	Soil -Saminaickenpatty Village
S3	Soil - Mottupatty Village
S4	Soil -Porasamarathukadu village

3.8.1 Methodology

The soil samples were collected during monitoring period. The samples collected from the all locations are homogeneous representative of each location. At random 10 sub locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

3.8.3 Soil Results

The detailed soil results of all the monitoring locations are as shown in **Table 3.13**.

Table 3.13: Chemical Characteristics of Soil in the Study Area

S.N	Test Parameters	IOCL Salem	Saminaickenpatty Village	Mottupatty Village	Porasamarathukadu village
01	**pH @ 25°C**	8.46	6.96	8.31	8.26
02	**Electrical Conductivity @ 25°C** µmhos/cm	206	1755	178	1685
03	**Particle Size Distribution**				
	a) 10 mm %	Nil	0.38	2.41	0.3
	b) 4.75 mm %	0.4	3.37	40.5	1
	c) 2 mm %	0.8	15.6	45.7	4.7
	d) 425 micron %	56	67.7	10.6	68.9
	e) 75 micron %	42.4	12.5	2.06	23.9
04	**Texture**				
	a. Percent Clay %	28	25	23	18
	b. Percent Silt %	64	69	32	76
	c. Percent Sand %	8	6	45	6
05	**Calcium as Ca** meq/L	1.36	2.6	1.81	1.52
06	**Magnesium as Mg** meq/L	1.15	2.2	1.54	1.30
07	**Sodium as Na(Soluble) in** meq/100g	2.4	4.6	3.2	2.7
08	**Potassium as K(Soluble) in meq/100g**	1.21	2.32	1.61	1.36
09	**Cation Exchange Capacity in** meq/100g	2.04	3.91	2.72	2.29
10	**Sodium Absorption Ratio** meq/L	2.14	2.97	2.47	2.3

3.9 Ecological and Bilogical Environment

3.9.1 Introduction

Assessment of biological environment provides information on the floral and faunal assemblages present within the proposed site and enables assessment of impacts of proposed project on these components. Further, based on the type and severity of the impact, suitable mitigation measures can be delineated.

3.9.2 Objectives

1. To carry out a systematic baseline survey of Flora and Fauna around 10 km radius of the study area
2. To list the plants and animals present in the study area as per the classifications of MOEF
3. To identify the impacts of the proposed expansion activities on the plants and animals
4. To evaluate the impacts of the proposed action, and to propose Environmental Management Plan

3.9.3 Scope of the work

1. The study is required to be carried out as part of EIA study as per the guidelines of the Ministry of Environment and Forests (MOEF) and State Pollution Control Board (SPCB).
2. The study should be based on the systematic field survey and secondary data (One season).

Flora

a) Area should be divided as core zone (0-3 kms) and buffer zone (10kms)
b) Listing of all species (scientific and local names) found in the study area - 10 km. Radius.
c) Based on the above findings Impacts of the proposed expansion.
d) Environmental Management plans to improve existing status of flora in the area.

Fauna

a) Core and Buffer zone divisions
b) Listing of all species in the study area of 10 km radius around the study area
c) Zoological and local name of the species should be furnished
d) Presence of endangered and endemic species should be supplemented by density.

Based on the above findings, impacts of proposed expansion should also be assessed.

3.9.4 Biological Environment Assessment - Flora & Fauna

A habitat or an area comprises of different kinds of plants and animals within its boundary. The distribution of flora and fauna in the given area represents the Biological portion of the environment that includes, what is present in the study area, its value, and its response to impacts, description of community uniqueness, the dominant species, and an evaluation of

rare or endangered species. The above studies were carried out using the standard methods proposed by John G. Rau and David C. Wooten 1980. The detailed ecological assessment of the study area has been carried out with the following objectives:

- Identification of flora and fauna and their biodiversity within the study area
- Preparation of checklist of species which also includes endangered, endemic and protected (both floral and faunal categories)
- Evaluation of impact of proposed project on flora and fauna of the area.

The ecological status of the study area has been assessed based on the following methodology:

- Primary field surveys to establish primary baseline of the study area
- Compilation of information available in published literatures and as obtained from Forest survey of India, Botanical Survey of India and Zoological Survey of India.

Flora

The Study of flora involved intensive sample survey of vegetation in the project site and other locations applying standard methods. To examine the trees and shrubs, quadrants of 25 x 25 m and for herbs 2 x 2 m were laid. In each of the larger quadrants (i) Species (ii) their number, and (iii) Girth at Breast Height (GBH), were measured. (Chaturvedi and Khanna, 1982).

Abundance, relative abundance, density and relative density of each species diversity and evenness for each of the Zones were calculated using the numerical data (Ludwig and Reynolds 1988, Lande 1996, Smith and Wilson 1996). The standard statistical analysis, the normal frequency diagram and distribution of plants in the study area were analyzed using the procedures of Raunkiaer, 1934. The analysis carried out as per Raunkiaer's law of frequency classes provides the information on the Heterogeneity and Homogeneity of plants and its pattern of distribution in the study area. The species of vegetation found in each station were identified and listed according to their families, both in dicotyledons and monocotyledons of the plant kingdom. The plant species were classified as per the classifications of "Bentham and Hooker" and identified by using Gambles book on "Flora of Madras Presidency" and Mathew's book on "Flora of the Tamil Nadu Carnatic".

Fauna

Both direct and indirect observation methods were used to survey the fauna. Visual encounter (search) method was employed to record vertebrate species. Additionally survey of relevant literature was also done to consolidate the list of vertebrate fauna distributed in the area (Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar 1988). Since birds may be considered as indicators for monitoring and understanding human impacts on ecological systems (Lawton 1996) attempt was made to gather quantitative data on the group by.

Point Survey Method: Observations were made in each site for 15 minutes duration.

Road Side Counts: The observer traveled by motor vehicles from site to site, all sightings were recorded (this was done both in the day and night time). An index of abundance of each species was also established.

Pellet and Track Counts: All possible animal tracks and pellets were identified and recorded (South Wood, 1978).

Based on the Wildlife Protection Act, 1972 (WPA 1972, Anonymous. 1991, Upadhyay 1995, Chaturvedi and Chaturvedi 1996) species were short-listed as Schedule II or I and considered herein as endangered species. Species listed in Ghosh (1994) are considered as Indian Red List species.

3.9.5 Assessment of Flora in the study area

Plant Communities

The Vegetation present within a defined area is termed as a plant community. This is determined by the nature of the dominant species it contains. By the term dominant species or dominance it is understood that species of plants having same life and growth, forms predominating in an area. A systematic order of angiosperm families recorded in the study area is given in Table. The distribution of vegetation at different sites, its density, dominance, frequency, Importance Value Index (IVI), economic importance, and medicinal uses were studied and the results are given in the following sections.

It was observed that the Flora, which includes herbs, shrubs and trees, were sparsely distributed in Core Zone. Around the core zone the natural vegetation showed moderate growth. The core zone has herbaceous and shrubby vegetation which are scarcely distributed. Among natural vegetation the common herbs such as Croton, common grasses like Aristida hysterix, Cynodon dactylon, were in the study areas. Less population of herbs were found in the core zone when compared to the buffer zone.

Stratification

Stratification, or layering, is the occurrence of plants at different levels in a stand. The number of strata above the ground varies according to the kind of community. The study sites are characterized by scrub and deciduous elements with low thorny trees and predominant xerophytes vegetation.

The strata were found in the entire field monitoring stations with equal representation. This shows the life – forms of the area and its amplitude. This also reflects the light intensity, temperature, and organic content of the soil and other factors of the area.

Periodicity (Phenology)

Periodicity refers to the regular seasonal occurrence of various processes such as photosynthesis, growth, pollination, flowering and ripening of fruits and seeds; and the manifestations of the processes, such as formation of leaves, elongation of shoots, appearance of flowers and dissemination of seeds. This results from the inherent genetic characteristics of each species, under the influence of a particular combination of the environmental conditions.

Periodicity means particularly the recurrence at certain times of these processes and their manifestations, while phenology refers more to the appearance of the manifestations at certain seasons of the year, rather than to their cyclic nature. The characteristic species of the scrub forests and other dominant plants are in flowering and are well adapted to the seasonal

changes in the physical environment. Periodicity and Phenology is perfectly maintained in the study area among the various species recorded during the survey.

Vitality (Vigor)
Vitality relates to the condition of plant and its capacity to complete the life cycle, while vigor refers more specifically to the state of health or development within a certain stage. The studies carried out at different sites reveals that the plant species found in the area are well-developed plants, which regularly complete their life cycle.

Life form
The life form in a broad sense is meant the characteristic vegetative appearance such as the size, shape, branching etc. The life form observed in the study area reveals that there are several communities ranging from open grassland, succulent perennials (Opuntia sps. and Euphorbia sps), and small annual plants. The kinds of life forms, the number of individuals of each kind and their spacing gives a good structure to the community.

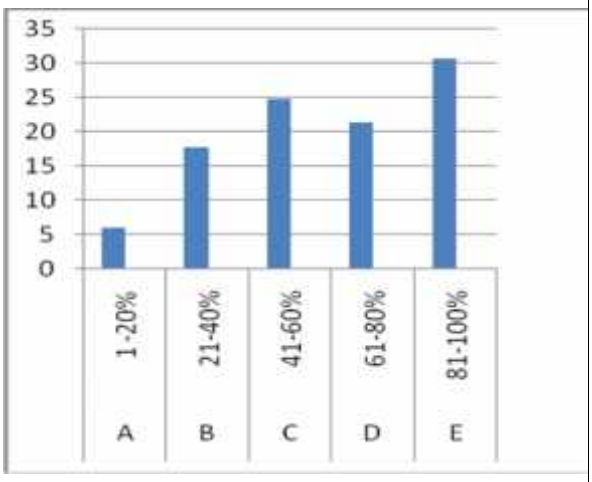
Quantitative Characteristics
The quantitative characteristics are the one, which can be readily measured. It includes density of the plants, basal area dominance and frequency.

Relative density and dominance
The relative density and dominance values of different species found in the study are shows that the dominant plants of various sites have a high percentage value of density and dominance. These values are incorporated in calculating the Importance value Index.

Importance value Index (IVI)
The Importance Value Index (IVI) is an expression used to summarize the plant data; it is desirable to use as many values as possible. The density of one species gives an idea of the number of plants in a stand; the dominance gives an idea of relative degree to which a species predominate a community by its numbers, size or biomass. Species that exerts the greatest control or influence in the community are called 'dominants'. Plant dispersion over an area or within a community is another parameter; frequency is the measure of species in a series of plots.

Frequency expresses the proportion of equal size sample plots in which at least one plant of that species occur relative to the number of plots taken. Thus the IVI of species is the combination of relative density, relative dominance and relative frequency values of a species added together to obtain a single expression. Importance value Index (IVI). The Importance value allows quantitative comparison of each species in a stand with the other species in the stand, or allows comparison of the species in one stand with species in other stands.

Status of flora as per Raunkiaer's frequency classes
Raunkiaer classified the occurrence of species in an area into five classes of frequency Class – A (1 to 20%), Class – B (21 to 40%) Class – C (41 to 60%) Class – D (61 to 80%) and Class – E (81 to 100). The normal distribution of the frequency percentages derived from such classification is expressed as A>B>C=D<E, and has been named Raunkiaer's "Law of Frequency". The numbers of species falling in the above five categories are given in the following tables. The ecological status of vegetation was calculated using the Raunkiaer's normal frequency diagrams and the results are given below for core zone.

Dominant Species	Status
Core Zone 0 – 3 Kms.	
Adhatoda zeylanica, Agave sisalana Perinne, Ailanthus excelsa Roxb, Aloe vera, Aristida hystrix, Asparagus racemosus, Azadirachta indica (L.) Adr. Juss. Cocos nucifera L, Emblica officinalis,Euphorbia antiquorum L.,Euphorbia tircalli L.,Ficus benghalensis L,Ficus religiosa L, Br.,Jasmimunofficinalae L,Mimosa pudica, Morinda tinctoria, Moringa olifera Lam, Phyllanthus emblica L, Pithecellobium dulce (Roxb) Benth, Pongamia pinnata a L.	**Heterogeneous** **Fulfills Raunkiaer's Law** 

Conclusions were made as per the Raunkiaer's law on the basis of the following

Whether the distribution of plants fulfils the Raunkiaer's law of frequency diagram, if it does not fulfill then it indicates that the distribution of plant community is affected by human impact.

A comment on the impact – whether the distribution is Homogeneous or Heterogeneous.

The result shows that, the distribution is Heterogeneous, in Core and Buffer zones thus fulfilling the Raunkiaer's law. The Heterogeneity observed among the plant community in the Core and Buffer zones reveals that, the characteristic species of scrub forests are dominant and occupies the class E. They were recorded in all the stands used for this investigation showing the highest frequency; there is a wide distribution of plant species observed in various stands. 100% Frequency were not recorded for many characteristic species except for Prosopis juliflora and Acacia nilotica. Though, these two species are dominant, the distribution of vegetation is heterogeneous in nature. The Heterogeneous status indicates that there is no human impact in the core and buffer zones.

Habitat pattern

The environmental conditions with one kind of habitat exhibit variation from spot to spot. The ecological amplitude of one or more of the species under consideration delimits the extent of a habitat. The habitat pattern is associated with the environmental conditions; this has been very well manifested in the study area. Though the topography is plain with some undulations here and there the presence of scrub elements and deciduous species clearly shows the habitat pattern in this area.

Changes

The Changes from the initial establishment of vegetation on an area to the terminal climax community are continuous. However, a given group of species will reach a peak of dominance at a certain stage of the sequence. Then as the dominance of this group decreases, the dominance of another group of species will develop to a maximum. This kind of change in dominant species have been observed in the study area, among different transects. The

Change from one stage to the subsequent stage may be especially prominent where there is a change of life form of the dominant species. There is usually an increase in productivity per unit area, in organic mass per unit area because of the presence of the larger life forms, in complexity and diversity of species and life forms, and in the relative stability and homogeneity of the populations. The soil and other aspects of the habitat will also undergo progressive development.

Climax

The Climax community is the one in which no further directional change takes place under the prevailing environmental conditions. This is the terminus of habitat and vegetation development. The climax community of the study area is Azadiracta indica and the grass like Ariztida hystrix. The climax community is in the steady state with respect to productivity structure and population, with the dynamic balance of its populations dependent upon its respective site. The community has a maximum diversity, relative stability and homogeneity of the species populations within and between the stands of a given climax type. The given climax type is characterized in appearance within and between stands.

Discussion on vegetation analysis

The interpretations based on the above analysis and the floristic composition reveals that, the vegetation encountered in the study area is termed as the original characteristic of Thorn forests / Scrub forests, Southern tropical dry deciduous forests, Northern mixed dry deciduous forests, and tropical dry ever green forests. The core zone comprises of Residential, commercial and agricultural and fallow lands.

The types of forest / vegetation found in the study area are Open scrub along with the representative elements of the deciduous and dry ever green forest types. Physiognomically it occurs in the shape of scrub woodland or thicket; the latter may be dense or discontinuous.

Floristically it is distinguished by some characteristic and preferential species (Braun Blanquet, 1932), exclusively or mostly confined to this vegetation type, in relation to the types described by champion (1936) and champion and Seth (1968).

Status of the plants

There is no endangered, threatened, or rare species of plants recorded in the study area.

<u>Assessment of Fauna in the study</u>

The details of fauna found in core zone and buffer zone are given in the following Table

S. NO.	Common Name	Scientific Name	Status
Butterflies and Insects			
1	Common crow	Euploea core core	C
2	Grass yellow	Terias hecabe	C
3	Dragon fly	Agrion sp & Petalura sp	C
4	Grasshopper	Hieroglyphus sp	C
5	Termite	Hamitermes silvestri	C
6	Ant	Monomorium indicum	C

Amphibians			
1	Common Indian Toad	Bufo melanostictus	C
Reptiles			
1	Common Garden lizard	Calotes versicolor	C
2	Common skink	Mabuya carinata	C
Birds			
1	Pond Heron	Ardeola grayii	C , R
2	Small Egret	Egretta intermedia	C , R
3	Pariah Kite	Milvus migrans govinda	C,R
4	Brahminy Kite	Haliastur indus	C, R
5	Shikra	Accipiter badius	C, R
6	Spotted Dove	Streptopelia chinensis	C, R
7	RoseRingedParakeet	Psittacula krameri	C, R
8	Pied Crested Cuckoo	Clamator jacobinus	C, R
9	Koel	Eudynamys scolopacea	C, R
10	Spotted Owlet	Athene brama	C , R
11	Palm Swift	Cypsiurus parvus	C , R
12	Whitebreasted Kingfisher	Halcyon smyrnensis	C, R
13	Green Bee-Eater	Merops orientalis	C, R
14	Indian Roller	Coracias benghalensis	C, R
15	Lesser Golden Backed Woodpeker	Dinopium benghalense	C , R
16	Black Drango	Dicrurus adsimilis	C , R
17	Common Myna	Acridotheres tristis	C, R
18	Indian Tree Pie	Dendrocitta vagabunda	C, R
19	House Crow	Corvus splendens	C, R
20	Jungle Crow	Corvus macrorhynchos	C, R
21	Common Wood Shrike	Tephrodornis pondicerianus	C , R
22	Redvented Bul Bul	Pycnonotus cafer	C, R
23	White headed Babbler	Turdoides affinis	C, R
24	House Sparrow	Passer domesticus	C, R

Mammals			
1	Indian Palm squirrel	Funambulus palmarum	C, R
2	Indian pipistrella	Pipistrellus coromandra	C, R
	C - Common	M -Migrant	R - Resident

Based on the above tables, the following observations were made:

Invertebrates
The insects in the study area are interrelated with each other and other organisms. They are in perfect balance in their existence. Some of them act as pests, while others are useful and beneficial to the environment and human beings.

Pisces
The lentic and lotic systems represent common fishes which supports the local people during the seasons. Since the 3 km radius is covered by Inam Kulathar Lake most of fishing activities takes place along the area.

Amphibians
The toads and frogs were the amphibians recorded in the study area. Many of them were seen along the Lentic water system and other areas.

Reptiles
The reptiles recorded in the study area include lizards, and snakes.

Birds
Birds play an important role in understanding the ecological balance and its interrelationships. The occurrence of birds in various locations largely depends on the site characteristics and their presence in different study sites reveals that there is a good relationship between the birds and other organisms and the environment. The maintenance of the eco-balance could be seen in the selected study areas.

Mammals
The distribution of mammals is largely dependent upon the environment of the respective areas. The mammals present in the study area include Mongoose, Indian palm Squirrel, etc. These mammals are spread over the study area.

3.10 Socio-Economic Environment

3.10.1 Introduction

Socio-economic assessment is an important part of the Environment Impact Assessment of any industrial project. It is conducted to develop the sustainability strategy for the area, where the industrial project would be executed. This section studies the socio-economic profile of the study area for the IOCL Salem project and analyses the baseline status as well as assess

the social impacts of the projects in the study area and suggest mitigation measures to the anticipated adverse impacts of the project. The socio-economic aspects in general, divided into economy, demography, education, health, employment & infrastructure in the study area.

3.10.2 Salem: Basic Information

Salem District is one of the biggest Districts in Tamilnadu. It is bounded on the North by Dharmapuri district, on the South by Namakkal and Erode districts, the Western ghats in the West and on the East by Villupuram District. It is geographically spread over an area of 5237 sq. km. and is administratively divided into 4 Revenue Divisions (Attur, Mettur, Salem and Sankari) and 9 Taluks. As per the 2011 census Salem district has a population of 3,482,056 representing 4.83 percent of the state population. The district has a population density of 665 persons per sq. km. Its population growth rate over the decade 2001-2011 was 15.44 percent. Salem district has a sex ratio of 954 females for every 1000 males, and a literacy rate of 72.86 percent. The district comprises of one Municipal Corporation, 4 Municipalities, 33 Town Panchayats and 30 Census towns. There are 585 Revenue Villages in Salem district. Of these, 517 villages are inhabited.

Table 3.14: Demographic Attributes for Salem District

1.	Area	5237 sq. km.
2.	Population	34.82 Lakhs
3.	Decadal Growth rate	15.44 %
4.	Male population	17.81 lakhs
5.	Female population	17.00 lakhs
6.	Density of population (persons per km^2.)	665
7.	Sex Ratio (females per 1000 males)	954
8.	Literacy	72.86 %
9.	Male literacy	80.24 %
10.	Female literacy	65.15 %
11.	Urban Population	69.16 %

Source: District Census Handbook, Salem, Census of India 2011

3.10.3 Socio-Economic Details Of Study Area

The data is collected and analysed using secondary sources viz. District Census Handbook, Statistical Abstract, Official Documents etc. The study area is spread over the district of Salem in Tamilnadu. The demographic profile, infrastructure facilities and socio-economic condition is being described under different classifications in the following section.

Methodology

The data is collected and analysed using secondary sources. The secondary data was collected and collated from sources such as viz. District Census Handbook 2011, Census of India website, District Statistical Abstract etc

Demography
In 2011, Salem had population of 3,482,056 of which male and female were 1,781,571 and 1,700,485 respectively. Salem District population constituted 4.83 percent of total Tamilnadu population. There was change of 15.44 percent in the population compared to population as per 2001. In the previous census of India 2001, Salem District recorded increase of 17.20 percent to its population compared to 1991.
Density of population for Salem district for 2011 is 665 people per sq. km. In 2001, Salem district density was at 575 people per sq. km. Salem district administers 5,237 square km of areas.

SC & ST Population
According to the 2011 census, the ratio of scheduled caste population to the total population is 16.67 percent in Salem district and the ratio of scheduled tribe population to the total population is 3.43 percent in the district. If things are looked out at gender wise, male and female scheduled caste population were 16.51 percent and 16.83 percent respectively. Similarly, male female scheduled tribe population were 3.40 percent and 3.46 percent respectively. The ratio of scheduled caste population in the district is low as compared to the ratio of the scheduled caste population in the state which is 20.01 percent, whereas the ratio of scheduled tribe population in the district is higher as compared to the population in state which is 1.1 percent.

Literacy
Average literacy rate of Salem in 2011 were 72.86 compared to 65.09 of 2001. If things are looked out at gender wise, male and female literacy were 80.24 and 65.15 respectively. For 2001 census, same figures stood at 74.39 and 55.20 in Salem District. Total literate in Salem District were 2,285,562 of which male and female were 1,285,107 and 1,000,455 respectively. In 2001, Salem District had 1,734,442 in its district.

Sex Ratio
With regards to Sex Ratio in Salem, it stood at 954 per 1000 male compared to 2001 census figure of 929. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 916 girls per 1000 boys compared to figure of 851 girls per 1000 boys of 2001 census data.
There were total 344,960 children under age of 0-6 against 351,859 of 2001 census. Of total 344,960 male and female were 180,002 and 164,958 respectively. Child Sex Ratio as per census 2011 was 916 compared to 851 of census 2001. In 2011, Children under 0-6 formed 9.91 percent of Salem District compared to 11.67 percent of 2001. There was net change of -1.76 percent in this compared to previous census of India.

Workforce
As per the Census 2011, the workforce in the Salem district is 1,694,160 which constitute 48.65 percent of the total population of the study area. Of the total workers 931,921 are rural and 762,239 are urban workers. This would mean that 55 percent of the total workers are rural and 45 percent are urban workers. The number of rural workers is about same to the urban workers. The total workforce comprises of 1,561,030 main workers and 133,130 marginal workers.

Main workers[1] constitute 92.14 percent of the total workers. The remaining (7.86 percent) are marginal workers[2]. Among the main workers, male main workers are 65.50 percent and 34.50 percent are female workers. Majority of main workers (54.39 percent) are from rural areas.

Occupational structure

The occupational structure of the population in the Salem district has been studied. The Main workers are classified on the basis of Industrial category of workers into the following four categories:

1. Cultivators
2. Agricultural Labourers
3. Household Industry Workers
4. Other Workers

Of the total main workers in the study area, about 50 percent is engaged as other workers. The type of workers that come under this category of 'Other Worker' include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport banking, mining, construction, political or social work, priests, entertainment artists, etc. In effect, all those workers other than cultivators or agricultural labourers or household industry workers are 'Other Workers'.

Table 3.15: Distribution of main workers by category

	Main Workers	Main Workers			
		Cultivators	Agricultural Labourers	Household Industry Worker	Other Workers
Rural	849,111	212,272	322,439	51,415	262,985
Urban	711,919	34,739	73,719	81,285	522,176
Total	1,561,030	247,011	396,158	132,700	785,161

After other workers category, cultivators (16 percent) and agricultural labour (25 percent) together constitute 41 percent of the total main workers. It reflects that agricultural sector has absorbed 41 percent of the main workers. Most of the main workers engaged in agricultural sector as cultivators & agricultural labourers are rural (83.14 percent) in nature. Only 9 percent of workers in the district are engaged as the household industry workers. In the other workers category, 66.51 percent of the total main workers in other category are urban in nature whereas only 33.49 percent are rural in nature. Thus it reflects that the opportunities for other category workers are more in urban areas of the Salem district as compared to the rural areas.

[1] Main workers were those who had worked for the major part of the year preceding the date of enumeration i.e., those who were engaged in any economically productive activity for 183 days (or six months) or more during the year.

[2] Marginal workers were those who worked any time at all in the year preceding the enumeration but did not work for a major part of the year, i.e., those who worked for less than 183 days (or six months).

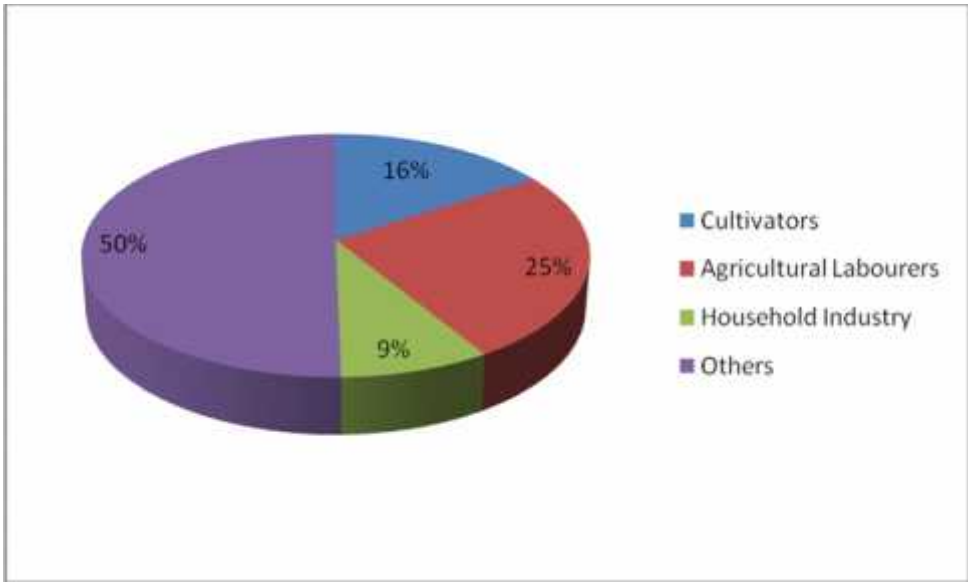


Figure 3.5: Percentage Distribution of Main Workers in the district

Industries

The Salem handloom industry is one of the most ancient cottage industries and producing quality sari, dothi and angavasthram out of silk yarn and cotton yarn. In the recent past, home furnishing items are also woven, mainly for export purposes. More than 75,000 handlooms are working and the total value of cloth produced per annum is estimated at Rs.5,000 crores. With more than 125 spinning mills, with modern weaving units and garment units Salem established itself as one of the major textile center in Tamil Nadu .The history of handloom and spinning mills dates back to pre-independence period in Salem. But till 1960s there were fewer than 5 spinning mills. Private handloom weaving started thriving in the region along with the large scale cooperative sector handloom weaving and marketing units. Small scale hand dying units were started around the region to support the industry. Around 1980s the textile industry grew significantly. Many major spinning mills and waste spinning units came up into existence. Many Handloom societies and dying houses were established. New and increased numbers of Power Loom units were mushroomed in the places like Gugai, Ammapet, Attayampatti, Vennandur, Magudanchavadi, Rasipuram, Komarapalayam Pallipalayam, Jalakandapuram and Ellampillai.

The Salem region also houses the Tamil Nadu largest number of Sago industries which are engaged in the production Sago Foods and Starch. In Salem District alone, 34000 hectares of land is under tapioca cultivation which is the raw material for the sago industries and there are 650 units engaged in tapioca processing. In and around Salem the yield of tapioca is about 25-30 T/ha, highest in the World. National average is 19 T/ha and World average production stands at 10 T/ha. Hence it is called land of sago. In 1981, Salem Starch and Sago Manufacturers Service Industrial Co-operative Society Ltd (popularly called as SAGOSERVE) was established to promote the growth of sago industries. Nearly 80% of the national demand for Sago and Starch is being met by the Sagoserv.

Salem Steel Plant, a special steel unit of Steel Authority of India Ltd have their plant located in Salem which produces Cold rolled stainless steel and Hot rolled stainless steel/carbon steel. The plant can produce austenitic, ferritic, martensitic and low-nickel stainless steel in the form of coils and sheets with an installed capacity of 70,000 tonnes/year in Cold Rolling Mill and 1,86,000 tonnes/year in Hot Rolling Mill. In addition, the plant has country's first

top-of-the-line stainless steel blanking facility with a capacity of 3,600 tonnes/year of coin blanks and utility blanks/circles. Expansion and modernisation of Salem Steel Plant is ongoing. The plan envisages installation of Steel Melting and Continuous Casting facilities to produce 1,80,000 tonnes of slabs along with expansion of Cold Rolling Mill complex, enhancing the capacity of Cold Rolled Stainless Steel Products from 65,000 TPA to 1,46,000 TPA and an additional Roll Grinding Machine for Hot Rolling Mill for increasing production to 3,64,000 TPA. The total project area is 1130 acres and cost of the project is 1780 crores.

Southern Iron & Steel Company Ltd (joint venture with JSW Steel) the first integrated steel plant of India at a cost of 2,235 Crores, located near Salem for the production of TMT corrosion resistant bars/alloy steels. The Salem plant is the largest special steel plant in India aims to develop the Kanjamalai, Kavuthimalai and Vediappanmalai iron ore mines in Tamil Nadu on receipt of requisite approvals to improve raw material security. This will facilitate expansion of production capacity to 2 MTPA. It will also allow the unit to diversify into the production of value-added products such as annealed, drawn and peeled steel. The plant is continuously working to develop special grades for critical automotive applications.

The Madras Aluminium Company Ltd (MALCO) is part of Vedanta Resources Plc, a London Stock Exchange listed FTSE 100 diversified metals and mining major. MALCO has a state-of-the-art, coal-based Captive Power Plant at the same location which was commissioned in the year 1999. In the year 2004 MALCO augmented its smelter capacity from earlier 25,000TPA to 40,000TPA. It generates 100 MW power from 4 units of 25MW each through power plant located at Mettur, Tamil Nadu. Around 90% of the entire power generated is exported; the rest is used internally. Efficient plant operations enabled MALCO to achieve a higher plant load factor since existence.

The region around Salem is rich in mineral ores. Salem has one of the largest magnesite, and bauxite and also iron ore deposits in India. It has many magnesite factories operated by private and public sectors such as Burn Standard & Co, Dalmia Magnesites and Tata Refractories, SAIL refractories. The Leigh Bazaar market in Salem is the biggest regional market for agro products. Narasus coffee one of the famous coffee in Tamil Nadu, Nandhi Dall Mills the oldest flour mill company, BSP refineries (Usha Refined Sunflower Oil) are other few companies have their presence in Salem.

Being one of the fastest growing tier II cities, the Tamil Nadu government and ELCOT are planning to establish an IT park in Salem covering about 160 acres (0.65 km2). SAIL is planning a Steel SEZ inside the Salem Steel plant covering about 250 acres (1.0 km^2). There is an exclusive Electrical and Electronics Industrial Estate in the Suramangalam area of Salem city. Coimbatore-Erode-Salem stretch was well known for Industries and Textile processing's and it is announced as Coimbatore-Salem Industrial Corridor and further development works are carried by SIPCOT Linking.

Agriculture

43% of land in Salem is used for agricultural activities to produce Maize, Turmeric, Tapioca, Tomato, Coir, Mango and Groundnut. Forests of Salem which account for 24% produce Sago, which is an important exportable product.

Agriculture provides the major source of income to the population of the district and the major crops in this district are paddy, cholam, cotton, groundnut, maize etc., In addition, the other allied sectors like dairy, sheep/ goat, sericulture, inland fishing are the major sectors

contributing to the district's economy as well as act as a major source of providing livelihood for improving the income and standard of living of the people.

The land use pattern in Salem district reveals that the net area sown and gross cultivated area is nearly 40 and 45.4 per cent of the total geographical area respectively. Forest area occupies the major area of 24.15 percent of the total geographical area. The cropping intensity is about 113 percent in Salem district. Salem district is not endowed with any major irrigation system except Mettur Dam which irrigates about 0.15 lakh hectares through the West Bank canal of the Cauvery. Wells are the main source of irrigation in Salem district which constitutes about 97per cent of the total area under irrigation; both net and gross irrigated area. The irrigation intensity is 82 percent.

Infrastructure

Out of the total Salem population for 2011 census, 50.95 percent lives in urban regions of district and 49.05 % population lives in rural areas of villages. This section analyses the infrastructure facilities like water supply, roads, markets, banks, post offices, schools and electrification in the study area. Salem town, the district headquarter is the biggest urban pocket in the district with excellent physical and social infrastructure and basic amenities.

Education

Salem district has many educational institutions including government schools, private schools (Holy Cross -Ammapet, Yercaud Montford, St. John's MHSS, Jayarani GHSS, Cluny convent, SRK Matric & Higher Secondary School, MALCO Vidyalaya, MAM Matric & Higher Secondary School (Mettur dam), Gov Matric & Higher Secondary School, St. Mary's School, Vaideeswara higher secondary school (Mettur RS), PKMGHS School (Madhanaicken patti) and hundred years traditional institution Government arts college (autonomous) Salem, Government arts college for women, Salem, Sri Sarada college for women, Vysya College, Jairam arts and science college, Thiagarajar Polytechnic college (Autonomous), Sona college of Engineering (Autonomous), Engineering colleges including the Government College of Engineering and Periyar University.

Table 3.16: Number of Educational Institutions

University of Periyar	1
Pharmacy	2
Medical Colleges	4
Nursing colleges	4
Engineering colleges	8
Law college	1
Teacher Training College	6
M.Phil	22
Schools for Special Education	3
Ph.D	17
Other Professional Institutions	28
Pre primary	265
Primary	1424
Middle	452
High School	239
Higher Secondary	271

Health Infrastructure

In Salem District One Head Quarters Hospital, Six Taluk Hospital, Two Non-Taluk Hospitals and One Government Dispensary are functioning in Medical and Rural Health Services side.

Government Hospitals	10
Private Hospitals	182
Ayurvedic Hospitals	62
Primary Health Centres	110
Health Sub Centres	398

Besides govt, there are a number of private nursing homes and private doctors providing health service to the people.

Access to Water

The district is endowed with rich water resources. The river Cauvery flows in the region and the major reservoir namely Stanley reservoir is located in the district. The inland water resource in the district includes a major reservoir, two minor reservoirs, long seasonal irrigational tanks and short seasonal ponds. Agricultural area is being irrigated by canals, tanks and groundwater. Several plans and schemes have been introduced for uninterrupted water supply for domestic and economic activities.

Road and Rail connectivity

Salem is endowed with infrastructural facilities on par with the best available in India. A network of all-weather metalled roads connecting every village exists in the district. The important National Highways criss-cross the district are NH 7 connects Salem to Kanyakumari & Varanasi, NH 47 connects Cochin to Salem and NH-68 Connects Ulundurpettai to Salem.

Salem is the headquarters of the Salem division of TNSTC. The city has two major bus stations: the MGR Integrated Bus Terminus in Meyyanoor and the Town Bus Station (Old Bus Stand) in the town area. Intercity and interstate routes and private buses originate at the Central Bus Stand, and local buses originate at the Old Bus Stand. The Anna Flyover is the oldest in the city, and the Trumpet Interchange was built in the realignment of NH 47 to ease traffic towards Coimbatore.

The rail network of Salem Junction falls under Salem division of Southern Railway. The network connects Salem to major cities in the country like Jammu, Delhi, Jaipur, Varanasi, Bangalore, Pune, Mumbai, Ahmedabad, Vishakhapatnam, Bhubaneswar, Howrah, Guwahati, Hyderabad, Nagpur, Jabalpur, Bhopal, Indore, etc. The total track length is of 160 Km (Broad gauge) and 122 Km (Meter gauge) in the district.

Salem Airport is located on the Salem-Bangalore Highway (NH 7) in Kaamalapuram about 15 kilometres from the city. Airports Authority of India (AAI) opened the airport in 1993 for commercial operations. Kingfisher Airlines flew from Chennai but ended its service in 2012 due to low occupancy. The nearest major airports are Tiruchirappalli, Coimbatore, Bangalore and Chennai.

CHAPTER 4. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 Introduction

This chapter presents identification and appraisal of various impacts due to proposed LPG project. Generally, the environmental impacts can be categorized as either primary or secondary. Primary impacts are those which are attributed directly to the project and secondary impacts are those which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed action.

In the present study, baseline environmental scenario was established through environmental monitoring data generated during the period of Jan2016 to March, 2016 by M/sEco Services India Pvt Ltd. It is that the impacts of the existing Salem bottling plant and other industrial projects located in the close vicinity are reflected in the baseline environmental scenario monitored for proposed expansion of Salem bottling plant.

The construction and operational phase of the proposed mounded bullets 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, which may be regarded as temporary or short term and reversible effect; and
- During operational phase which may have long term effects.

The evaluation of environmental impacts due to installation of mounded bullets considering the baseline status within a radius of 10 km around the Salem bottling plant and the mitigation measures are as under:

4.2 Impact Assessment

4.2.1 Construction Phase

Impacts on Land/Soil Environment

During site preparation, excavation will be done at places in the project site where sheds, Mounded 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
- Filth generation if dry waste/garbage generated during construction period is not handling efficiently

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

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 would 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

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

Impacts on Ecology and Biodiversity

- During construction activities vegetation may be disturbed which can be considered insignificant.
- Earth enabling work involving excavation and filling up operations may result in fugitive dust emission. Deposition of fugitive dust on pubescent leaves of nearby vegetation may lead to temporary reduction of photosynthesis.
- The runoff from construction area may lead to a short-term increase in suspended solids and decrease in dissolved oxygen near the discharge point in receiving water body. This

may lead to a temporary decrease in the photosynthetic activity of phyto-planktons, rise in anaerobic conditions and food chain modification.

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 would 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.

4.2.2 Operation Phase

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

Impacts on Air Environment

- No emission is envisaged during the storage and handling of LPG in mounded 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.

Impacts on Noise Environment

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

Impacts on Water Environment

- Stress on existing water supply
- Generation of waste water & domestic effluent

- Increased run off from site.

Impacts on Ecology and Biodiversity

- The probability and consequences of significant ecological impacts occurring as a result of the operation of the Mounded Bullets/facility are considered to be almost negligible. The risk of any leakage is almost negligible owing to stringent leak prevention technologies.
- In normal condition, no waste water is discharged outside the bottling plant. During monthly mock-drill and in monsoon, the waste/rain water will be discharged through properly designed storm water drain after passing through vapour trap.

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.

4.3 Impact Mitigation Measures

4.3.1 Construction Phase

Land/Soil Environment Impact Mitigation

- 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 CPCB
- 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 Salem Municipal Corporation waste disposal facility
- Chemicals/Paints etc. used during construction phase will be stored safely

Air Impact Mitigation

- Checking of vehicles and construction machinery to ensure compliance to Indian Emission Standards

- 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 CPCB
  - 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.

Noise Impact Mitigation

- No noise polluting work in night shifts
- Acoustic enclosures for DG Sets will be provided as per CPCB guidelines
- 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 the CPCB noise standards[3]
- 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.

[3] http://CPCB.nic.in/divisionsofheadoffice/pci2/Noise-vehicle.pdf

http://cpcb.nic.in/divisionsofheadoffice/pci2/noise_rules_2000.pdf

Water Impact Mitigation

- 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 duringoperation of the LPG Plant

Ecology and Biodiversity Impact Mitigation

- The impacts as mentioned earlier, however, be confined mostly to the initial periods of the construction phase and would be minimized through adoption of control measures such as paving and surface treatment, water sprinkling and plantation schemes.
- The impact would be restricted within the plant boundary. Thus, the impacts of construction activities will be marginal in scale.
- However, for major part of the year during construction phase, no detectable impact is expected because water quality will not change significantly. Hence, no tangible impact on the aquatic eco-system is anticipated.

Socio-Economic Environment Impacts Mitigation

- 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.

4.3.2 Operation Phase

Land/Soil Environment Impact Mitigation

- 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 dearler by CPCB

- The solid domestic waste shall be segregated and stored within the premises temporarily and then sent to Salem Municipal Corporation waste management facility

Air Impact Mitigation

- Checking of vehicles and construction machinery to ensure compliance to Indian Emission Standards[4]
- 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 CPCB
- Stack height of DG sets shall be as per norms of CPCB to allow effective dispersion of pollutants
- 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

Noise Impact Mitigation

- 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.

Water Impact Mitigation Measures

- waste water shall be recycled /resued for flushing, gardening and cooling tower makeup)
- Rain water harvesting shall be promoted. Rainwater from the landscape area and hardscape 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.

Ecology and Biodiversity Impact Mitigation

- The proponent has a plan of extensive green belt programme. The area, varieties of plants, density etc. have been mentioned in the report
- In normal condition, no waste water shall be discharged outside the plant. During mock-drill (once in a month) and rainy season, the waste/rain water shall be discharged through properly designed storm water drain. Hence, no impact is envisaged on aquatic ecology from the operation of facilities.

[4] http://cpcb.nic.in/divisionsofheadoffice/pci2/Noise-vehicle.pdf

http://cpcb.nic.in/divisionsofheadoffice/pci2/noise_rules_2000.pdf

[4] http://cpcb.nic.in/Vehicular_Exhaust.php

- The probability and consequences of significant ecological impacts occurring as a result of the operation of the facility are considered to be almost negligible. The risk of any leakage is almost negligible owing to stringent leak prevention technologies.

Socio-Economic Environment Impacts Mitigation

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

4.4 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 4.1: 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					√
2	Change in land use					√
3	Loss of trees/vegetation		√			
4	Shifting of equipment, machinery and material					√
5	Employment for local people		√			
Construction Phase						
1	Pressure on infrastructure and transportation system			√		
2	Impact on air quality including dust generation			√		

S.N.	Activity	Positive Impact		Negative Impact		No Impact
		Short Term	Long Term	Short Term	Long Term	
3	Noise Pollution			√		
4	Traffic					√
5	Impact on the land/soil environment			√		
6	Impact on groundwater					√
7	Stacking and disposal of construction material			√		
8	Impact on water quality			√		
9	Health and safety conditions of people			√		
10	Social impact	√				
11	Economic impact	√				
Operation Phase						
1	Increase in air pollution and noise levels				√	
2	Water harvesting and recharge		√			
3	Disposal of solid waste				√	
4	Infrastructure development		√			
5	Quality of life		√			
6	Handling operations for transfer, charging of raw materials, final product				√	

4.5 Summary of Environment Impacts and Mitigation Measures

The summary of the Impacts and Mitigation measures for the above mentioned environmental attributes is as summarized in **Table 4.2.**

Table 4.2: Summary of Impacts and Mitigation Measures

Impacting Activity		Potential Impact		Mitigation Measures Environment/ Social Attribute	Compliance/ Standards/ Best Practice Guidelines Source Contaminants
Environment / Social Attribute	Source Contaminants	Environment	Health and Safety		
Construction Phase					

Impacting Activity		Potential Impact		Mitigation Measures Environment/ Social Attribute	Compliance/ Standards/ Best Practice Guidelines Source Contaminants
Environment / Social Attribute	Source Contaminants	Environment	Health and Safety		
Construction Workers	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 far as possible. • Proper sanitation facilities will be provided for the workers • There are no temporary shelters provided because local workers will be engaged	--
Air Emissions	Dust and air emission particularly due to the excavation, construction and movement of vehicles resulting in air pollution	Rise in RSPM level 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 topsoil to be preserved and reused for landscaping • Ensuring all vehicles, generators and compressors are shall be maintained and regularly serviced	CPCB - National Ambient Air Quality Standards
Noise Generation	Construction noise mainly due to excavation, Moving of vehicles, operations of cranes etc.	Rise in decibel level of ambient noise	Unwanted sound can cause problems within the body. Excessive noise pollution in working areas at construction sites can influence psychological health viz. occurrence of aggressive behaviour, disturbance of sleep, constant stress, fatigue and hypertension.	• The vehicles used will be with the proper acoustic measures • Wherever this cannot be achieved the area will be earmarked as high noise level area requiring use of ear protection gadgets • Avoid night time work	CPCB - Noise Pollution (Regulation and Control) Rules

Impacting Activity		Potential Impact		Mitigation Measures Environment/ Social Attribute	Compliance/ Standards/ Best Practice Guidelines Source Contaminants
Environment / Social Attribute	Source Contaminants	Environment	Health and Safety		
			Hampered sleeping pattern and may lead to irritation and uncomfortable situations.		
Soil and Groundwater Contamination	• Spillage of concrete mixture containing additives and plasticizers. • Spillage of construction material containing heavy metals, paints, coatings, liners, etc.			• All fuel, Liquid Cargo storage will be sited on an impervious base within a bund and secured place. The base and bund walls will be impermeable to 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 deliveries 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 emission from the DG Sets in case of power failure and operation of fire Engine in case of fire drill or emergency	• Negligible Impact	Negligible Impact	• The DG sets shall be provided with Stack Height per CPCB guidelines above roof level.	
Wastewater	Domestic waste water	• Negligible Impact	Negligible	• Septic Tank and Soak Pit	

Impacting Activity		Potential Impact		Mitigation Measures Environment/ Social Attribute	Compliance/ Standards/ Best Practice Guidelines Source Contaminants
Environment / Social Attribute	Source Contaminants	Environment	Health and Safety		
	arising from Restroom and Canteen		Impact	shall be provided for domestic sewage.	
Hazardous Materials, Fire and Explosion		• Risk of fire and explosions due to the flammable and combustible nature of petroleum products. • Risk of leaks and accidental releases from equipment, tanks, pipes etc during loading and unloading (handling)	Potential risk of loss of life or injury due to fire	Storage equipment should meet standards for structural design and integrity. .	OISD-STD 144 - Fire Protection Facilities for LPG Bottling Plant.
Hazardous Waste	• No Hazardous Waste except used lubricating Oil	Same to be Stored in barrels	• To be Srored in Designated place on Concree platform		To be disposed to CPCB accredited Party.

CHAPTER 5: PROJECT BENEFITS

5.1 Project Benefits

The Proposed project will have indirect positive impact on surrounding area which is as mentioned below:

- Plant will be set up on barren land; hence no displacement of people is required.
- Substantial Socio-economic benefits.
- Good Techno-commercial viability.
- Around the project site semi-skilled and unskilled workmen are expected to be available from local population in these areas to meet the manpower requirement during construction and Operational phase.
- There will be employment opportunity for local people during construction and operation phase.
- Infrastructural facilities will be improved due to the project.
- Critical analyses of the existing socio-economic profile of the area indicate that the impact of the Project is expected to be of varying nature. The following are the impacts predicted.
- Secondary employment will be generated thereby benefiting locals.
- Project will have substantial benefits in savings of transportation cost
- Thus a significant benefit to the socio-economic environment is likely to be created due to the project.

5.2 Improvements in the Physical Infrastructure

The project will improve supply position of LPG in Tamil Nadu State.

- Maintain continuity of LPG gas cylinder supply to the consumers through distributors.
- Increase the days cover for LPG storage.
- Safety measures for hazard detection and prevention system will be upgraded as per OISD-144/OISD-150.
- By adding 3x900 MT Mounded Bullets, risk profile of the existing plant will not be enhanced;
- Discourage deforestation and reduce the use of fire wood and fossil fuels.

Establishment of large developmental projects improve the availability of the physical infrastructures like approach roads, drainage, communication and transportation facilities etc.

5.3 Improvements in the Social Infrastructure

IOCL Salem LPG Plant shall take up some community welfare activities under Corporate Social Responsibility and also improve the social infrastructures like education and health care system etc.

5.4 Employment Potential

The project shall provide employment potential under unskilled, semi-skilled and skilled categories. The employment potential shall increase with the start of construction activities, reach a peak during construction phase and then reduce with completion of construction activities. During operation phase also there will be employment opportunities, mainly in service sector, although its magnitude will be much less.

The direct employment opportunities with IOCL are extremely limited and the opportunities exist mainly with the contractors and sub-contractors. These agencies will be persuaded to provide the jobs to local persons on a preferential basis wherever feasible.

The total employment potential of plant is 60 people which will include 20 direct and 40 indirect that includes contract labours and even security personnels.

5.5 CSR and Socio-Economic Development

IOCL not only carries out business but also understands the obligations towards the society. The unit is aware of the obligations towards the society and to fulfill the social obligations unit will employ semi-skilled and unskilled labor from the nearby villages for the proposed project as far as possible. Unit will also try to generate maximum indirect employment in the nearby villages by appointing local contractors during construction phase as well as during operation phase. The Project Proponents will contribute reasonably as part of their Corporate Social Responsibility (CSR) in and will carry out various activities in nearby villages.

Moreover, unit has planned to carry out various activities for the up-liftment of poor people, welfare of women and labors, education of poor students as part of CSR in the nearby villages and therefore , during and after proposed project, unit will spent more than that required by statutory norms every year towards CSR activities. The various CSR activates planned at present by the unit is described below;

- Plantation along the road side and development of garden/greenbelt on government barren land/common plots
- Education aids and scholarship to poor students
- Organize medical camp and providing support for the development and maintenance of the health facilities
- Financial support and assistance for the development and maintenance of the infrastructure facilities
- Participate and contribute in local social programs
- Organize various types of training program for the community like training on scientific agricultural practices, educational training, (training for tailoring, embroidery), etc. which ultimately helpful for income generation
- Organize various types of awareness program for the community like awareness on the child labor, educational promotion etc.

The activities listed above are not limited to and IOCL will plan and perform other activities according to the need of local community in future. The utilization of this fund in various areas with time bound action plan will be decided based on the requirement of the local community.

5.6 Direct Revenue Earning to the National and State Exchequer

This project will contribute additional revenue to the Central and State exchequer in the form of excise duty, income tax, state sales tax or VAT, tax for interstate movement, corporate taxes etc. Indirect contribution to the Central and State exchequer will be there due to Income by way of registration of trucks, payment of road tax, income tax from individual as well as taxes from associated units. Thus, the proposed project will help the Government by paying different taxes from time to time, which is a part of revenue and thus, will help in developing the area.

5.7 Other Tangible Benefits

Both tangible and non-tangible benefits will result from this activity and many of those are described above. Apart from direct employment, many other benefits will accrue like

- Erosion control by nalla training, terracing and bunding
- Aesthetics improvement by general greening with emphasis on biodiversity
- Developed economy strengthens democratic set-up.
- Developed economy brings with it literacy and healthful living
- Improved safety-security in surrounding with better Law and Order
- Symbiosis and sustainable development will be the ultimate objective

CHAPTER 6: ANALYSIS OF ALTERNATES

6.1 Alternative Technology

LPG is a gas stored and handled in liquefied form under pressure. LPG is commonly stored in horizontal dish-end cylindrical mild steel tanks (commonly known as bullets). The major types of LPG storage facilities are given below:

1. Above ground LPG bullet
2. Buried LPG bullet
3. Mounded LPG bullets

Above ground LPG bullet

These are mounted on two RCC saddles. Each tank is fitted with liquefied gas inlet line entering into the tank from top. The vapour outlet line for direct use of the gas in the plant is also taken out from the top of each tank. The bottom connections include liquid discharge line to vaporizer and drain line with two isolation valves and with its end outside the shadow of the tank. Each tank is provided with multiple pressure relief valves with discharge capacities enough to avoid undue pressure rise under fire in the vicinity of the tank. Each tank is also fitted with rotogauge (a device to check the level of liquefied gas), pressure gauge and temperature gauge.

Buried LPG Bullets

Buried LPG bullets are supported by saddles resting on foundations in order to minimize the chance of unexpected settling and any motion of the bullets underground. The large span of these bullets requires more than two saddles adding to the complexity of the design due to statically indeterminate construction, differential settlement, and uneven supports. First, the loads induced by mound weight, pressure due to mound, and the loads due to longitudinal thermal expansion and soil resistance to this expansion is analyzed.

Diameters and lengths of bullets are significant and using a common foundation for all of the saddles is not economical. As a result, saddles are usually supported on separate independent foundations resting on piles. The construction represents a challenge for the designer, because it is much more complex than conventional design analysis for a vessel supported on two saddles. Horizontal vessels supported by two saddles can be analyzed as a beam resisting the uniform load.

Mounded LPG bullets

A safer option was introduced in the form of Mounded LPG Storage Bullets since it provides intrinsically passive and safe environment and eliminates the possibility of BLEVE (Boiling Liquid Expanding Vapour Explosion). Mounded LPG Bullets are large, buried, horizontal cylindrical steel tanks with dished ends of size ranging between 7.0 meter to 7.5 meter diameter and lengths of 54.0 meter to 55.0 meters or more.

Mounded bullets allow storage of large quantities of LPG up to 2,000 MT or more in a single location. The cover of the mound protects the vessel from fire engulfment, radiation from a fire in close proximity and acts of sabotage or vandalism. The area of land required to locate a mounded system is minimal compared to conventional storage. Mounded bullets were supported directly by soil without using additional supports such as saddles.

The project proposal relates to installation of 03 nos. of Mounded Bullets of 900MT capacity each for storage of LPG.IOCL has mastered the art and technology of installation of

Mounded Bullets. The LPG department of Marketing Division of IOCL has earned a good credential for installation of Mounded Bullets.

The above expertises of IOCL are well proven and working efficiently at different locations of the country without fail. IOCL is having excellent track record and progressive outlook in regularly updating its technology. The technology adopted by IOCL for installation of Mounded Bullets for storage of LPG is a fail-safe.

6.2 Alternative Site

The proposed expansion will be carried out in the vacant land of existing Salem bottling plant terminal. Hence, no alternate sites were considered for the project. The land required for the expansion of the facilities is already in possession of IOCL.

CHAPTER 7. ADDITIONAL STUDIES

7.1 Public Consultation

As per requirement of the Notification, TNPCB will conduct Public Consultation and the report will be submitted to SEIAA TN. The summary of points raised during Public consultation will be considered for action at our end.

7.2 Quantitative Risk Assessment

7.2.1 Scope of Study

The scope of the QRA is given below:

- Identification of Hazards and Major Loss of Containment (LOC) events.
- Calculation of physical effects of accidental scenarios, which includes frequency analysis for incident scenarios leading to hazards to people and facilities (flammable gas, fire, and smoke and explosion overpressure hazards) and consequence analysis for the identified hazards covering impact on people and potential escalation.
- Damage limits identification and quantification of the risks and contour mapping on the plant layout.
- Risk contour mapping.
- Evaluation of risks against risk acceptable limit
- Risk reduction measures to prevent incident to control the accident
- Hazard mitigation recommendations based on QRA
- Provide consolidated conclusion on QRA of location

7.2.2 Description of the Facility

The main operation of LPG Bottling Plant in Salem is to receive bulk LPG, store into mounded storage vessels, bottle in cylinders and dispatch the same to distributors in Salem and adjoining districts.
The plant handles Liquefied Petroleum Gas and the composition (by mole fraction) is as follows: Propane: 0.55
Butane: 0.45
The storage capacity of LPG is proposed to be expanded to 2700MT from 1200 MT. It supplies LPG cylinders to Salem, Dharmapuri & Krishnagiri and some areas of Trichy and Chennai. The plant has LPG and others materials which might have an impact on the surrounding public.

List of hazardous materials stored/ used:

LPG - for bottling in cylinders	2700 MT
HSD consumer pump- own use, transporters	30KL
LUBE OIL - Lubricant for engines	1KL
CHAINKOTE – Soap solution for chain conveyors	2.5 MT

7.2.3 Methodology

Risk Analysis is proven valuable as a management tool in assessing the overall safety performance of the Chemical Process Industry. Although management systems such as engineering codes, checklists, and reviews by experienced engineers have provided substantial safety assurances, major incidents involving numerous casualties, injuries and significant damage can occur - as illustrated by recent world-scale catastrophes. Risk Analysis techniques provide advanced quantitative means to supplement other hazard identification, analysis, assessment, control and management methods to identify the potential for such incidents and to evaluate control strategies.

The underlying basis of Risk Analysis is simple in concept. It offers methods to answer the following four questions:

1. What can go wrong?
2. What are the causes?
3. What are the consequences?
4. How likely is it?

This study tries to quantify the risks to rank them accordingly based on their severity and probability. The report shall be used to understand the significance of existing control measures and to follow the measures continuously. Wherever possible the additional risk control measures shall be adopted to bring down the risk levels. The methodology adopted for the QRA Study has been depicted in the Flow chart given below:

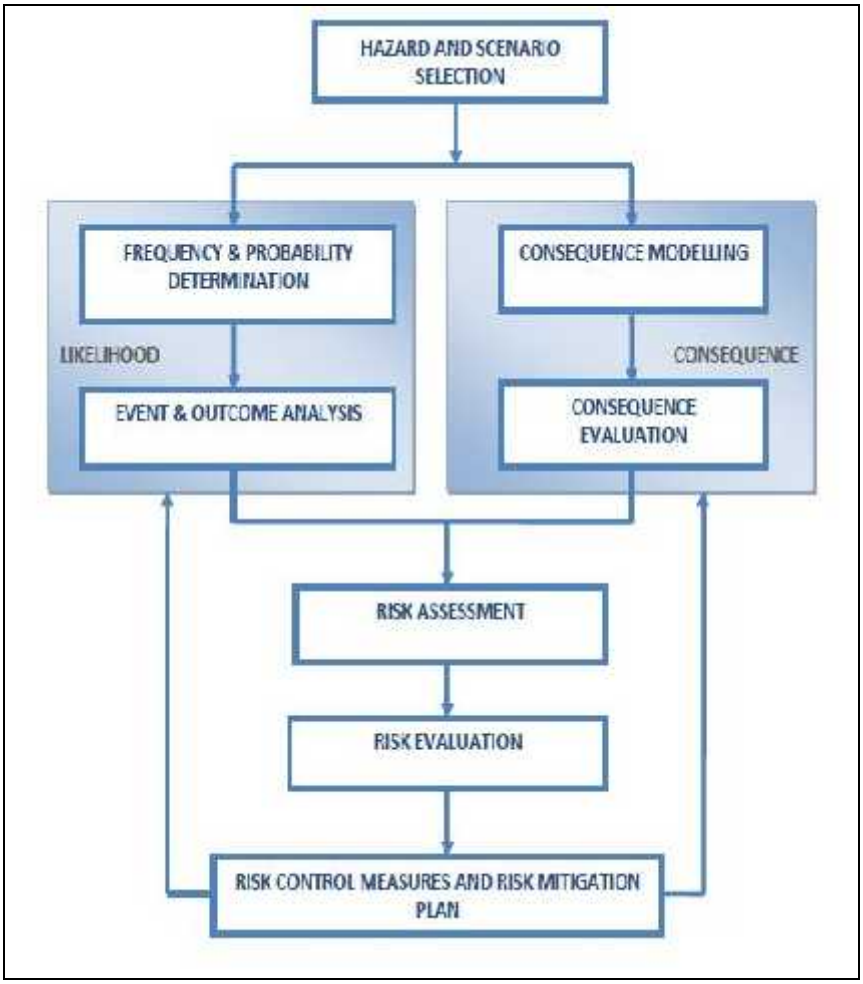


Figure 7.1: Methodology

7.2.4 Risk Assessment Procedure

Hazard identification and risk assessment involves a series of steps as follows:

Step 1: Identification of the Hazard

Based on consideration of factors such as the physical & chemical properties of the fluids being handled, the arrangement of equipment, operating & maintenance procedures and process conditions, external hazards such as third party interference, extreme environmental conditions, aircraft / helicopter crash shall also be considered.

Step 2: Assessment of the Risk

Arising from the hazards and consideration of its tolerability to personnel, the facility and the environment, this involves the identification of initiating events, possible accident sequences, and likelihood of occurrence and assessment of the consequences. The acceptability of the estimated risk must then be judged based upon criteria appropriate to the particular situation.

Step 3: Elimination or Reduction of the Risk

Where this is deemed to be necessary, this involves identifying opportunities to reduce the likelihood and/or consequence of an accident.

Hazard Identification is a critical step in Risk Analysis. Many aids are available, including experience, engineering codes, checklists, detailed process knowledge, equipment failure experience, hazard index techniques, What-if Analysis, Hazard and Operability (HAZOP) Studies, Failure Mode and Effects Analysis (FMEA), and Preliminary Hazard Analysis (PHA). In this phase all potential incidents are identified and tabulated. Site visit and study of operations and documents like drawings, process write-up etc. are used for hazard identification.

Assessment of Risks

The assessment of risks is based on the consequences and likelihood. Consequence Estimation is the methodology used to determine the potential for damage or injury from specific incidents. A single incident (e.g. rupture of a pressurized flammable liquid tank) can have many distinct incident outcomes (e.g. Unconfined Vapour Cloud Explosion (UVCE), flash fire.

Likelihood assessment is the methodology used to estimate the frequency or probability of occurrence of an incident. Estimates may be obtained from historical incident data on failure frequencies or from failure sequence models, such as fault trees and event trees. In this study the historical data developed by software models and those collected by CPR18E – Committee for Prevention of Disasters, Netherlands (Edition: PGS 3, 2005) are used.

Risk Assessment combines the consequences and likelihood of all incident outcomes from all selected incidents to provide a measure of risk. The risks of all selected incidents are individually estimated and summed to give an overall measure of risk.

Risk-reduction measures include those to prevent incidents (i.e. reduce the likelihood of occurrence) to control incidents (i.e. limit the extent & duration of a hazardous event) and to mitigate the effects (i.e. reduce the consequences). Preventive measures, such as using inherently safer designs and ensuring asset integrity, shall be used wherever practicable. In many cases, the measures to control and mitigate hazards and risks are simple and obvious and involve modifications to conform to standard practice. The general hierarchy of risk reducing measures is:

- Prevention (by distance or design)
- Detection (e.g. fire & gas, Leak detection)
- Control (e.g. emergency shutdown & controlled depressurization)
- Mitigation (e.g. firefighting and passive fire protection)
- Emergency response (in case safety barriers fail)

Identificationof Hazards and Release scenarios

A technique commonly used to generate an incident list is to consider potential leaks and major releases from fractures of all process pipelines and vessels. This compilation includes all pipe work and vessels in direct communication, as these may share a significant inventory that cannot be isolated in an emergency. The following data were collected to envisage scenarios:

- Composition of materials stored in vessels / flowing through pipeline
- Inventory of materials stored in vessels
- Flow rate of materials passing through pipelines
- Vessels / Pipeline conditions (phase, temperature, pressure)
- Connecting piping and piping dimensions.

Accidental release of flammable liquids / gases can result in severe consequences. Delayed ignition of flammable gases can result in blast overpressures covering large areas. This may lead to extensive loss of life and property. In contrast, fires have localized consequences. Fires can be put out or contained in most cases; there are few mitigating actions one can take once a flammable gas or a vapour cloud gets released. Major accident hazards arise, therefore, consequent upon the release of flammable gases.

Factors for Identification of Hazrds

In any installation, main hazard arises due to loss of containment during handling of flammable liquids / gases. To formulate a structured approach to identification of hazards, an understanding of contributory factors is essential.

Blast over Pressures

Blast Overpressures depend upon the reactivity class of material and the amount of gas between two explosive limits. These gases in general have medium reactivity and in case of confinement of the gas cloud, on delayed ignition may result in an explosion and overpressures.

Operating Parameters

Potential gas release for the same material depends significantly on the operating conditions. The gases are likely to operate at atmospheric temperature (and hence high pressures). This operating range is enough to release a large amount of gas in case of a leak / rupture, therefore the pipeline leaks and ruptures need to be considered in the risk analysis calculations.

Inventory

Inventory Analysis is commonly used in understanding the relative hazards and short listing of release scenarios. Inventory plays an important role in regard to the potential hazard. Larger the inventory of a vessel or a system, larger is the quantity of potential release. A

practice commonly used to generate an incident list is to consider potential leaks and major releases from fractures of pipelines and vessels/tanks containing sizable inventories.

Range of Incidents

Both the complexity of study and the number of incident outcome cases are affected by the range of initiating events and incidents covered. This not only reflects the inclusion of accidents and / or non-accident-initiated events, but also the size of those events. For instance studies may evaluate one or more of the following:

- catastrophic failure of container
- large hole (large continuous release)
- smaller holes (continuous release)
- leaks at fittings or valves (small continuous release)

In general, quantitative studies do not include very small continuous releases or short duration small releases if past experience or preliminary consequence modeling shows that such releases do not contribute to the overall risk levels.

Selection of Initiating Events And Incidents

The selection of initiating events and incidents shall take into account the goals or objectives of the study and the data requirements. The data requirements increase significantly when non -accident - initiated events are included and when the number of release size increase. While the potential range of release sizes is tremendous, groupings are both appropriate and necessitated by data restrictions. The main reasons for including release sizes other than the catastrophic are to reduce the conservatism in an analysis and to better understand the relative contributions to risk of small versus large releases.

As per CPR 18 E guidelines & Reference Manual BEVI Risk Assessments Version 3.2 only the Loss of Containment (LOC) which is basically the release scenarios contributing to the individual and/ or societal risk are included in the QRA. LOCs of the installation are included only if the following conditions are fulfilled:

- Frequency of occurrence is equal to or greater than 10-8 and
- Lethal damage (1% probability) occurs outside the establishment’s boundary or the transport route.

There may be number of accidents that may occur quite frequently, but due to proper control measures or fewer quantities of chemicals released, they are controlled effectively. A few examples are a leak from a gasket, pump or valve, release of a chemical from a vent or relief valve, and fire in a pump due to overheating. These accidents generally are controlled before they escalate by using control systems and monitoring devices – used because such piping and equipment are known to sometimes fail or malfunction, leading to problems.

On the other hand, there are less problematic areas / units that are generally ignore or not given due attention. Such LOCs are identified by studying the facilities and Event Tree Analysis etc. and accidents with less consequence are ignored. Some of the critical worst

case scenarios identified by the Hazard Identification study are also assessed as per the guidelines of Environment Protection Agency.

7.2.5 Types of Outcome Events

In this section of the report we describe the probabilities associated with the sequence of occurrences which must take place for the incident scenarios to produce hazardous effects and the modeling of their effects.

Considering the present case the outcomes expected are

- Jet fires
- Vapour Cloud Explosion (VCE) and Flash Fire (FF)

- **Jet fires**

Jet fire occurs when a pressurized release (of a flammable fluid) is ignited by any source. They tend to be localized in effect and are mainly of concern in establishing the potential for domino effects and employee safety zones rather than for community risks.

The jet fire model is based on the radiant fraction of total combustion energy, which is assumed to arise from a point slowly along the jet flame path. The jet dispersion model gives the jet flame length.

- **Vapour Cloud Explosion (VCE)**

Vapour cloud explosion is the result of flammable materials in the atmosphere, a subsequent dispersion phase, and after some delay an ignition of the vapour cloud. Turbulence is the governing factor in blast generation, which could intensify combustion to the level that will result in an explosion. Obstacles in the path of vapour cloud or when the cloud finds a confined area, as under the bullets, often create turbulence. Insignificant level of confinement will result in a flash fire. The VCE will result in overpressures.

It may be noted that VCEs have been responsible for very serious accidents involving severe property damage and loss of lives. Vapour Cloud Explosions in the open area with respect to Pure Methane is virtually impossible due to their lower density.

7.2.6 Probabilities

- **Population Probabilities**

It is necessary to know the population exposure in order to estimate the consequences and the risk resulting from an incident. The exposed population is often defined using a population density. Population densities are an important part of a QRA for several reasons. The most notable is that the density is typically used to determine the number of people affected by a

given incident with a specific hazard area. Sometimes, population data are available in sketchy forms. In the absence of specific population data default categories can be used.

The population density can be averaged over the whole area that may be affected or the area can be subdivided into any number of segments with a separate population density for each individual segment. The population data for the outside population and inside population has been taken as provided by the local IOCL management.

Population in the Proposed Bottling Plant and in the surrounding;

S.No.	Location	Population
1	Tankfarmarea	15
2	Adminbuilding	15
3	Canteen	30
4	Pumphouse	4
5	TLD	15
6	Fillingshed	40
7	Controlroom	4
8	PMCC/DGroom	5
9	FWpumphouse	4
10	Security	10
11	Car Parkingarea	20
12	TTparkingarea	110
13	Store	2
14	College	2000
15	Village	15000
16	Railwayline	1500
17	Industry	1500

- **Failure/Accident Probabilities**

The failure data is taken from CPR 18E –Guidelines for Quantitative Risk Assessment, developed by the Committee for the Prevention of Disasters, Netherlands.

The failure frequency data and list of scenarios is given in **Table 7.5**.

- **Weather Probabilities**

The following meteorological data is used for the study:

Wind Speed : 1.5m/s and 5m/s
Atmospheric Temperature : 33.5°C
Atmospheric Pressure : 101.325 KN/m^2
Humidity : 72%
Solar Radiation : 0.12kW/m2
Wind stability class : F & D (1.5F & 5D)

Wind proportion in each direction with respect to each wind speed is calculated and tabulated below based on the wind rose chart of Salem.

Table 7.3 Wind Proportion Details

wind speed m/s	0	>0.3	>1.6	>3.4	>5.5	>8	>10.8	>13.9	>17.2	Total in terms of wind direction
N	0.00080	0.02671	0.03071	0.00114	0.00011	0.00000	0.00000	0.00000	0.00000	0.059475
NNE	0.00057	0.02203	0.03916	0.00708	0.00023	0.00000	0.00000	0.00000	0.00000	0.069064
NE	0.00023	0.01758	0.04304	0.02546	0.00331	0.00000	0.00000	0.00000	0.00000	0.089612
ENE	0.00103	0.02409	0.05023	0.02705	0.00696	0.00000	0.00000	0.00000	0.00000	0.109361
E	0.00000	0.01484	0.02922	0.01747	0.00297	0.00000	0.00000	0.00000	0.00000	0.064498
ESE	0.00080	0.01975	0.02260	0.00902	0.00046	0.00000	0.00000	0.00000	0.00000	0.052626
SE	0.00034	0.01381	0.00925	0.00114	0.00000	0.00000	0.00000	0.00000	0.00000	0.024543
SSE	0.00000	0.01096	0.00662	0.00023	0.00000	0.00000	0.00000	0.00000	0.00000	0.017808
S	0.00171	0.01701	0.01039	0.00023	0.00000	0.00000	0.00000	0.00000	0.00000	0.029338
SSW	0.00023	0.01107	0.01598	0.00148	0.00000	0.00000	0.00000	0.00000	0.00000	0.028767
SW	0.00068	0.01358	0.06107	0.01393	0.00240	0.00011	0.00000	0.00000	0.00000	0.091781
WSW	0.00000	0.01210	0.09018	0.03881	0.01929	0.00251	0.00000	0.00000	0.00000	0.1629
W	0.00080	0.01598	0.04909	0.05171	0.02854	0.02409	0.01073	0.00023	0.00000	0.181164
WNW	0.00023	0.00765	0.00822	0.00502	0.00194	0.00034	0.00000	0.00000	0.00000	0.023402
NW	0.00057	0.01062	0.00742	0.00046	0.00000	0.00000	0.00000	0.00000	0.00000	0.019064
NNW	0.00000	0.01301	0.01598	0.00034	0.00000	0.00000	0.00000	0.00000	0.00000	0.029338

7.2.7 Stability Class

The tendency of the atmosphere to resist or enhance vertical motion and thus turbulence is termed as stability. Stability is related to both the change of temperature with height (the lapse rate) driven by the boundary layer energy budget, and wind speed together with surface characteristics (roughness).

A neutral atmosphere neither enhances nor inhibits mechanical turbulence. An unstable atmosphere enhances turbulence, whereas a stable atmosphere inhibits mechanical turbulence.

Stability classes are defined for different meteorological situations, characterized by wind speed and solar radiation (during the day) and cloud cover during the night. The so called

Pasquill-Turner stability classes' dispersion estimates include six (6) stability classes as below:

A – Very Unstable
B – Unstable
C – Slightly Unstable
D – Neutral
E – Stable
F – Very Stable

The typical stability classes for various wind speed and radiation levels during entire day are presented in **Table 7.4**:

Table 7.4: PasquiIl's Stability Class

Wind Speed (m/s)	Day : Solar Radiation			Night : cloud Cover		
	Strong	Moderate	Slight	Thinly < 40%	Moderate	Overcast > 80%
<2	A	A-B	B	-	-	D
2-3	A-B	B	C	E	F	D
3-5	B	B-C	C	D	E	D
5-6	C	C-D	D	D	D	D
>6	C	D	D	D	D	D

For the study purpose, and consistent with good industry practice, the following weather conditions have been considered:

- 1.5F - F stability class and wind speed of 1.5m/sec
- 5D - D stability class and wind speed of 5m/sec

➢ **Ignition Probabilites**

For gas/ oil releases from the gas/ oil handling system, where a large percentage of rupture events may be due to third party damage, a relatively high probability of immediate ignition is generally used.

Delayed ignition takes other factors into account. Delayed ignition probabilities can also be determined as a function of the cloud area or the location. In general as the size of the cloud increases, the probability of delayed ignition decreases. This is due to the likelihood that the cloud has already encountered an ignition source and ignited before dispersing over a larger area (i.e. the cloud reaches an ignition source relatively close to the point of origin).

For this study the ignition probabilities have been modified to suit the existing site conditions. The ignition probabilities inside enclosed areas shall be much higher than the open areas. It is because of the fact that there will be much more activities taking place and the possibility of ignition increases.

In this study the following probabilities were taken as per CPR 18 E.

Ignition probability for this site: 0.5 for 60 sec for road transport; 0.01 for 60 sec for transmission line

7.2.8 Scenario Selection

- **Scenario Selection of QRA Study**

This section documents the consequence-distance calculations, which have been computed for the accident release scenarios considered

In Risk Analysis studies contributions from low frequency - high outcome effect as well as high frequency - low outcome events are distinguished; the objective of the study is emergency planning, hence only holistic & conservative assumptions are used for obvious reasons. Hence though the outcomes may look pessimistic, the planning for emergency concept shall be borne in mind whilst interpreting the results.

For this study rupture of LPG storage tank is not considered as it's a mounded storage so the possibility of rupture of tank is nearly impossible. Similarly rupture of Road tanker within the IOCL scope is not possible so it is not considered for the study.

The following are the LOC scenarios which were selected for modeling.

Table 7.5: List of Scenarios & Failure Frequency

S. No	Scenario	Description	Pressure, Bar	Temperature °C	Flow rate, m^3/hr.	Diameter, m	Length of the Pipeline or equipment, m	Total Inventory m^3	Calculated failure frequency
IS 1	Leak	LPG from Road tanker to Bullet	8	30	90	0.2032	75	2.745973991	3.75E-07
	Rupture				90	0.2032	75	5.43096288	7.50E-08
IS 2	Leak	LPG storage bullet (ROV upstream flange leak)	8	30	-	7	54	900 MT	1.00E-07
IS 3	Leak	LPG from bullet to pump suction	8	30	48	0.1016	15	0.436559255	3.00E-07
	Rupture				48	0.1016	15	1.721548144	4.50E-08
IS 4	Leak	LPG pump dis to filling carousal	18	30	48	0.1016	110	1.363599723	2.20E-06
	Rupture				48	0.1016	110	2.491353056	3.30E-07
IS 5	Leak	LPG vapor from bullet to compressor inlet	8	40	255	0.1016	15	0.436559255	3.00E-07
	Rupture				255	0.1016	15	8.614881477	4.50E-08
IS 6	Leak	LPG vapor from compressor discharge to TLD	10	55	255	0.1016	50	0.454177813	1.00E-06
	Rupture				255	0.1016	50	8.898493813	1.50E-07
IS 7	Leak	Vapor recovery from tanker to compressor inlet	8	40	255	0.1016	50	0.720171591	1.00E-06
	Rupture				255	0.1016	50	8.898493813	1.50E-07
IS 8	Leak	LPG vapor from compressor discharge to bullet inlet	9	55	255	0.1016	15	0.165679477	3.00E-07
	Rupture				255	0.1016	15	8.614881477	4.50E-08
IS 9	Leak	Unloading arm	8	30	12	0.1016	2	0.33121753	8.76E-06
	Rupture				12	0.1016	2	0.416206419	8.76E-07
IS 10	Leak	Main evacuation hose leak	6	30	18	0.0381	1.5	0.005991737	1.31E-03

7.2.9 Consequencce Analysis

➢ **Consequence Calculations**

In consequence analysis, use is made of a number of calculation models to estimate the physical effects of an accident (spill of hazardous material) and to predict the damage (lethality, injury, material destruction) of the effects.

Accidental release of flammable liquids / gases can result in severe consequences. Immediate ignition of the pressurized chemical will result in a jet flame. Delayed ignition of flammable vapors can result in blast overpressures covering large areas. This may lead to extensive loss of life and property. In contrast, fires have localized consequences. Fires can be put out or contained in most cases; there are few mitigating actions one can take once a vapour cloud gets released.

The calculations can roughly be divided in three major groups:

a) Determination of the source strength parameters;
b) Determination of the consequential effects;
c) Determination of the damage or damage distances.

The basic physical effect models consist of the following.

➢ **Source strength parameters**

- Calculation of the outflow of liquid out of a vessel / Tank or a pipe, in case of rupture. Also Two-phase outflow can be calculated.
- Calculation, in case of liquid outflow, of the instantaneous flash evaporation and of the dimensions of the remaining liquid pool.
- Calculation of the evaporation rate, as a function of volatility of the material, pool dimensions and wind velocity.
- Source strength equals pump capacities, etc. in some cases.

➢ **Consequential effects**

- Dispersion of gaseous material in the atmosphere as a function of source strength, relative density of the gas, weather conditions and topographical situation of the surrounding area.
- Intensity of heat radiation [in kW/ m^2] due to a fire, as a function of the distance to the source.
- Energy of vapour cloud explosions [in N/m^2], as a function of the distance to the distance of the exploding cloud.
- Concentration of gaseous material in the atmosphere, due to the dispersion of evaporated chemical. The latter can be either explosive or toxic.
- It may be obvious, that the types of models that must be used in a specific risk study strongly depend upon the type of material involved:
- Gas, vapour, liquid, solid
- Inflammable, explosive, toxic, toxic combustion products

- Stored at high/low temperatures or pressure
- Controlled outflow (pump capacity) or catastrophic failure

➢ **Selection of Damage Criteria**

The damage criteria give the relation between the extents of the physical effects (exposure) and the effect of consequences. For assessing the effects on human beings consequences are expressed in terms of injuries and the effects on equipment / property in terms of monetary loss.

The effect of consequences for release of toxic substances or fire can be categorized as

- Damage caused by heat radiation on material and people;
- Damage caused by explosion on structure and people;
- Damage caused by toxic exposure.

In Consequence Analysis studies, in principle three types of exposure to hazardous effects are distinguished:

1. Heat radiation due to fires. In this study, the concern is that of Jet fires and flash fires.
2. Explosions
3. Toxic effects, from toxic materials or toxic combustion products.

The knowledge about these relations depends strongly on the nature of the exposure. Following are the criteria selected for damage estimation:

➢ **Heat Radiation:**

The effect of fire on a human being is in the form of burns. There are three categories of burn such as first degree, second degree and third degree burns. The consequences caused by exposure to heat radiation are a function of:

➢ The radiation energy onto the human body [kW/m^2];

➢ The exposure duration [sec];

➢ The protection of the skin tissue (clothed or naked body).

The limits for 1% of the exposed people to be killed due to heat radiation, and for second-degree burns are given in the **Table7.6** below:

Table 7.6: Effects Due To Incident Radiation Intensity

Incident Radiation (kW/m^2)	**Type Of Damage**
0.7	Equivalent to Solar Radiation
1.6	No discomfort for long exposure
4.0	Sufficient to cause pain within 20 sec. Blistering of skin (first degree burns are likely)

Incident Radiation (kW/m^2)	Type Of Damage
9.5	Pain threshold reached after 8 sec. second degree burns after 20 sec.
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing's etc.
37.5	Damage to process equipment's

The actual results would be less severe due to the various assumptions made in the models arising out of the flame geometry, emissivity, angle of incidence, view factor and others. The radiative output of the flame would be dependent upon the fire size, extent of mixing with air and the flame temperature. Some fraction of the radiation is absorbed by carbon dioxide and water vapour in the intervening atmosphere. Finally the incident flux at an observer location would depend upon the radiation view factor, which is a function of the distance from the flame surface, the observer's orientation and the flame geometry.

Assumptions made for the study (As per the guidelines of CPR 18E Purple Book)

- The lethality of a jet fire is assumed to be 100% for the people who are caught in the flame. Outside the flame area, the lethality depends on the heat radiation distances.
- For the flash fires lethality is taken as 100% for all the people caught outdoors and for 10% who are indoors within the flammable cloud. No fatality has been assumed outside the flash fire area.

Overpressure:

Vapour cloud Explosion (VCE)

The assessment aims is to determine the impact of overpressure in the event that a flammable gas cloud is ignited. The TNO multi energy model is used to model vapour cloud explosions.

A Vapour cloud Explosion (VCE) results when a flammable vapor is released, its mixture with air will form a flammable vapour cloud. If ignited, the flame speed may accelerate to high velocities and produce significant blast overexposure.

The damage effects due to 30 mbar, 100 mbar & 300 mbar are reported in terms of distance from the overpressure source.

In case of vapour cloud explosion, two physical effects may occur:

- A flash fire over the whole length of the explosive gas cloud;
- A blast wave, with typical peak overpressures circular around ignition source.
- For the blast wave, the lethality criterion is based on:
- A peak overpressure of 0.1bar will cause serious damage to 10% of the housing/structures.
- Falling fragments will kill one of each eight persons in the destroyed buildings.

The following damage criteria may be distinguished with respect to the peak overpressures resulting from a blast wave:

Table 7.7: Damage due to overpressure

Peak Overpressure	Damage Type	Description
0.30 bar	Heavy Damage	Major damage to plant equipment structure
0.10 bar	Moderate Damage	Repairable damage to plant equipment & structur
0.03 bar	Significant Damage	Shattering of glass
0.01 bar	Minor Damage	Crack in glass

Assumptions for the study (As per the guidelines of CPR 18 E Purple Books)

- Overpressure more than 0.3bar corresponds approximately with 50% lethality.
- An overpressure above 0.2bar would result in 10% fatalities.
- An overpressure less than 0.1bar would not cause any fatalities to the public.
- 100% lethality is assumed for all people who are present within the cloud proper.

7.2.10 Consequence Results

Table 7.8: Consequence Results

Scenario No	Description	Weather	Jet Fir			Flash Fire	Explosion		
			4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	LFL	0.03 bar	0.1 bar	0.3 bar
IS1 L	LPG from road tanker to bullet	1.5 F	30.97	24.83	21.09	16.6965	63.61	50.07	45.03
		5 D	27.39	20.85	16.95	11.7745	38.22	27.77	23.88
IS 1R		1.5 F	110.87	88.00	74.33	102.264	335.49	263.52	236.71
		5 D	99.12	74.74	60.39	107.685	287.27	225.75	202.84
IS2 L	LPG storage bullet (ROV upstream flange leak)	1.5 F	20.7347	9.60718	NR	52.3407	NA	NA	NA
		5 D	20.8607	12.4239	7.25855	46.1592	NA	NA	NA
IS3 L	LPG from bullet to pump suction	1.5 F	31.62	25.35	21.53	17.15	64.16	50.30	45.15
		5 D	27.97	21.28	17.31	12.162	48.68	37.96	33.98
IS3 R		1.5 F	66.03	52.65	44.62	52.3407	185.85	148.08	134.02
		5 D	58.79	44.52	36.10	46.1592	144.88	113.41	101.69
IS4 L	LPG pump dis to filling carousal	1.5 F	36.86	29.53	25.09	21.2659	79.62	62.63	56.31
		5 D	32.63	24.82	20.20	15.9598	63.02	49.82	44.90
IS4 R		1.5 F	77.28	61.55	52.13	63.5212	218.58	173.51	156.73
		5 D	68.84	52.08	42.22	58.3253	186.31	148.28	134.12
IS5 L	LPG vapor from bullet to compressor inlet	1.5 F	6.55	NR	NR	3.7652	NA	NA	NA
		5 D	6.42	NR	NR	3.2823	NA	NA	NA
IS5 R		1.5 F	21.6144	16.9537	12.1641	10.745	35.6936	26.693	23.342

Scenario No	Description	Weather	Jet Fir			Flash Fire	Explosion		
			4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	LFL	0.03 bar	0.1 bar	0.3 bar
		5 D	21.9979	18.1811	14.4463	8.715	23.728	15.8547	12.92
IS6 L	LPG vapor from compressor discharge to TLD	1.5 F	7.29	NR	NR	4.03919	NA	NA	NA
		5 D	7.17	NR	NR	3.52116	NA	NA	NA
IS6 R		1.5 F	26.90	21.13	16.42	13.7791	49.67	38.39	34.19
		5 D	27.31	22.52	18.53	11.1702	37.02	27.26	23.62
IS7 L	Vapor recovery from tanker to compressor inlet	1.5 F	6.55	NR	NR	3.76	NA	NA	NA
		5 D	6.42	NR	NR	3.28	NA	NA	NA
IS7 R		1.5 F	21.2164	16.6849	11.9776	10.4417	35.3083	26.5286	23.26
		5 D	21.5466	17.8079	14.072	8.5269	23.4292	15.7272	12.8598
IS8 L	LPG vapor from compressor discharge to bullet inlet	1.5 F	6.81	NR	NR	3.84014	38.24	16.31	8.14
		5 D	6.66	NR	NR	3.35803	38.24	16.31	8.14
IS8 R		1.5 F	26.45	20.78	16.12	13.508	49.32	38.24	34.11
		5 D	26.85	22.15	18.22	10.9116	36.69	27.12	23.55
IS9 L	Unloading arm	1.5 F	30.97	24.83	21.09	16.6965	63.61	50.07	45.03
		5 D	27.39	20.85	16.95	11.7745	38.22	27.77	23.88
IS9 R		1.5 F	91.30	44.65	NR	91.7865	147.09	62.73	31.32
		5 D	91.30	44.65	NR	93.0422	147.09	62.73	31.32
IS10 L	Main evacuation hose leak	1.5 F	NR	NR	NR	NR	12.03	5.13	2.56
		5 D	NR	NR	NR	NR	12.03	5.13	2.56

Legend:
NA➔ Not Applicable NR ➔ Not Reached

- **Impact Analysis:**

As highlighted in table above, the maximum damage distance reached for Flash Fire is for cases IS-1, LPG from road tanker to bulletat 5D weather condition. The maximum damage distance for Flash Fire is 107m (LFL).

The maximum damage distance reached for Jet Fire is for IS-1, LPG from road tanker to bulletat 1.5F weather condition. First degree burns can be experiences up to a distance of 111 (4 kW/m2), second degree burns (piloted ignition of wood, etc.) can be experienced up to a distance of 88m (12.5kW/m2); 99% fatality (damage to process equipment) can be experienced up to a distance of 74 m.

As highlighted in table above, the maximum damage distance reached is for the case IS-1 LPG from road tanker to bulletat 1.5 F weather condition. 10% of window glasses are broken up to a distance of 335.5 m, repairable damage to building and houses can be experienced up to a distance of 263.5m and Heavy machines (3000 lb.) in industrial building suffered little damage, steel frame building and pulled away from foundations can be experienced up to a distance of 236.7m.

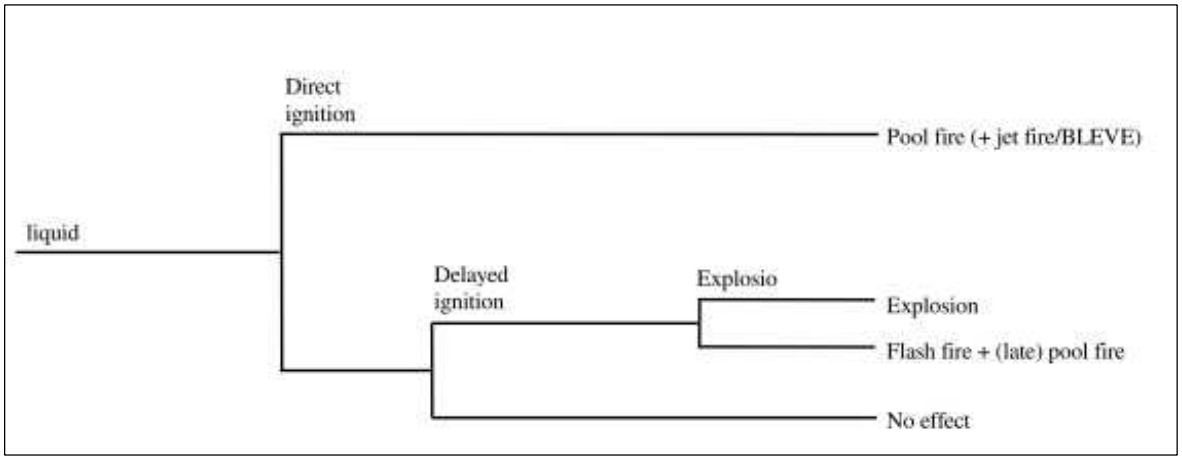
- **Frequency Analysis**

Frequency estimates have been obtained from historical incident data on failure frequencies and from failure sequence models (event trees). In this study the historical data available in international renowned databases will be used.

Reference Manual Bevi Risk Assessments version 3.2
CPR 18E – Committee for Prevention of Disasters, Netherlands
The scenario list and frequencies are available in Table No. 4

- **Event tree analysis**

A release can result in several possible outcomes or scenarios (fire, explosions, unignited release etc.). This is because the actual outcome depends on other events that may or may not occur following the initial release. Event tree analysis is used to identify potential outcomes of a release and to quantify the risk associated with each of these outcomes.



The above event tree is used for calculating the event frequencies and the probabilities are defined in below:

- **Immediate Ignition Probability**

Release Rate	Immediate Ignition Probability (for Low / Medium Reactive Chemicals)	Delayed Ignition Probability
< 10 kg/sec	0.02	0.01
10 to 100 kg/sec	0.04	0.05
> 100 kg/sec	0.08	0.1

The above table from Bevi manual & CPR 18E is used for ignition probability.

- **Explosion Probability**

In the sequence of events, following the ignition of a free gas cloud, an incident occurs demonstrating characteristics of both a flash fire and an explosion. This is modeled as two separate events: as a pure flash fire and a pure explosion. The fraction that is modeled as an explosion, F explosion, is equal to 0.4.

The leak detection and shutdown systems are classified as Automatic, Semi-automatic & Manual systems based on the leak detection facilities.

7.2.11 Risk Analysis

- **Risk Concept**

Risk in general is defined as a measure of potential economic loss or human injury in terms of the probability of the loss or injury occurring and magnitude of the loss or injury if it occurs. Risk thus comprises of two variables; magnitude of consequences and the probability of occurrence. The results of Risk Analysis are often reproduced as Individual and groups risks and are defined as below.

Individual Risk is the probability of death occurring as a result of accidents at a plant, installation or a transport route expressed as a function of the distance from such an activity. It is the frequency at which an individual or an individual within a group may be expected to sustain a given level of harm (typically death) from the realization of specific hazards.

Such a risk actually exists only when a person is permanently at that spot (out of doors). The

Individual results are based on the occupancy factor for different category of personnel's at that particular location.

Individual Risk = Location Specific Individual risk * Occupancy factor

Whereas, location specific individual risk corresponds to the level of damage at a particular location or area.
The exposure of an individual is related to:

- The likelihood of occurrence of an event involving a release and Ignition of hydrocarbon,
- The vulnerability of the person to the event,
- The proportion of time the person will be exposed to the event (which is termed ‘occupancy’ in the QRA terminology).

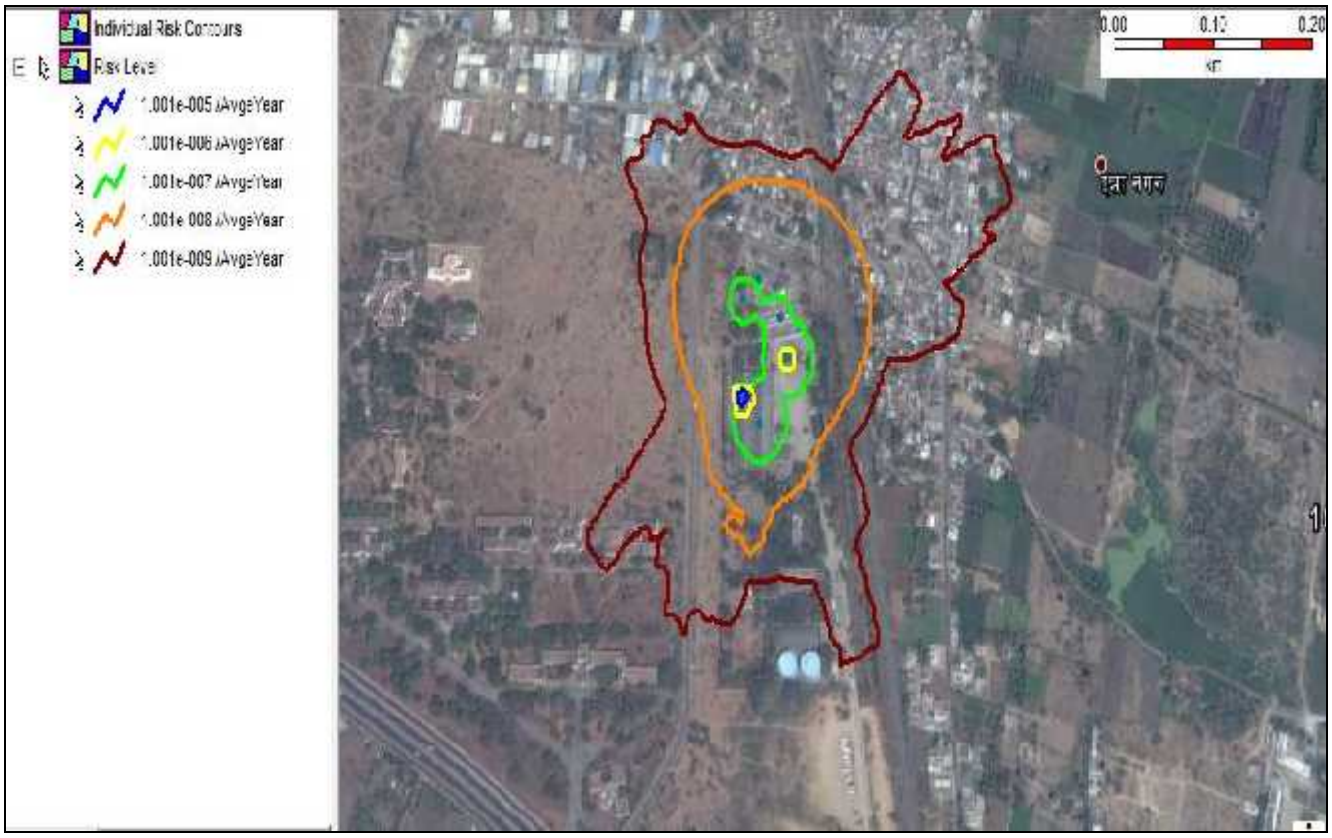
The second definition of risk involves the concept of the summation of risk from events involving many fatalities within specific population groups. This definition is focused on the risk to society rather than to a specific individual and is termed **'Societal Risk'**. In relation to the process operations we can identify specific groups of people who work on or live close to the installation; for example communities living or working close to the plant.

- **Risk Estimation**

Individual Risk

The Individual Risk (IR) measure, expresses the risk exposure to any Individual who is continuously present in a particular area for the whole year. The risk exposure is calculated for all relevant hazards and summed to give the overall risks for the installation. The IR output from PHASTRISK is shown below:

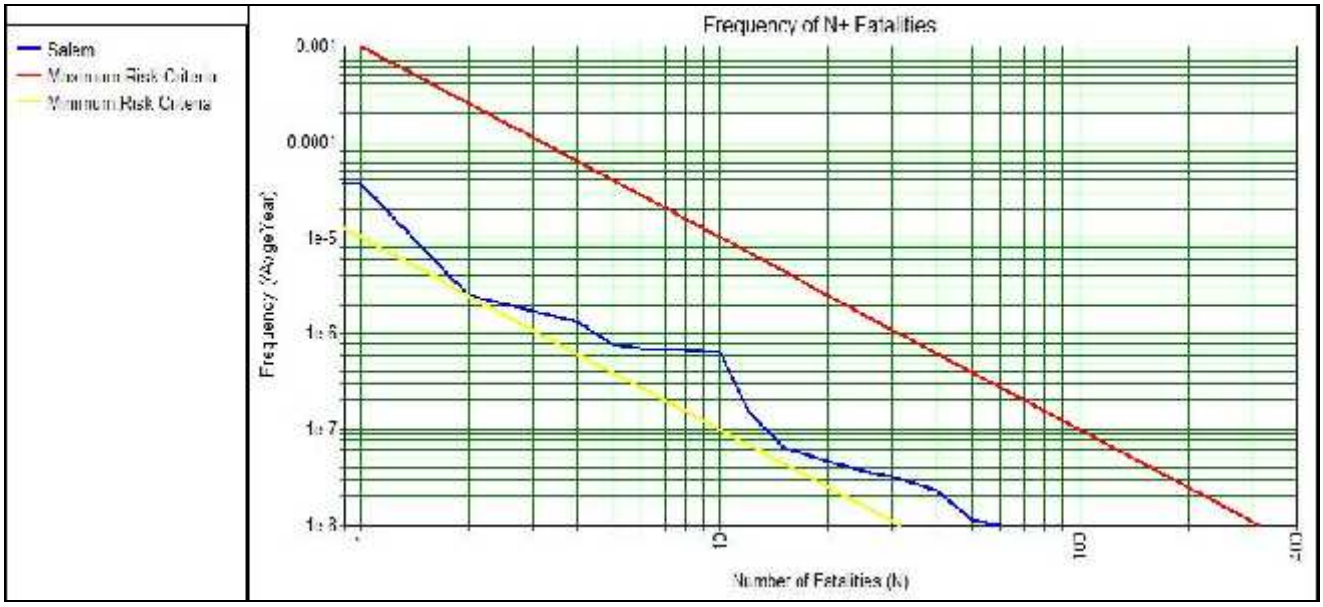
Combined Individual Risk at 1.5F weather condition;



Societal Risk

The SR output from PHASTRISK for LPG Bottling Plant, Salemis shown below:

Societal Risk at 1.5F& 5D weather condition;
Societal Risk is 4.78 E-05 Per Avg Year



Individual and Societal risk of each scenarios is given below in the **Table 7.9**

Table 7.9: Individual and Societal Risk of each scenarios

Scenarios	Description	Individual Risk per Avg year	Societal Risk perAvg year
IS1 L	LPG from Road tanker to Bullet	3.56E-08	4.97E-08
IS1 R	LPG from Road tanker to Bullet	3.71E-07	4.01E-07
IS2 L	LPG storage bullet (ROV upstream flange leak)	Negligible	Negligible
IS3 L	LPG from bullet to pump suction	2.34E-11	1.84E-11
IS3 R	LPG from bullet to pump suction	7.46E-09	9.82E-09
IS4 L	LPG pump dis to filling carousal	1.92E-06	1.63E-06
IS4 R	LPG pump dis to filling carousal	1.97E-06	1.82E-06
IS5 L	LPG vapor from bullet to compressor inlet	1.55E-11	1.53E-11
IS5 R	LPG vapor from bullet to compressor inlet	4.99E-07	5.87E-07
IS6 L	LPG vapor from compressor discharge to TLD	1.77E-11	6.11E-12

Scenarios	Description	Individual Risk per Avg year	Societal Risk perAvg year
IS6 R	LPG vapor from compressor discharge to TLD	4.74E-09	3.55E-09
IS7 L	Vapor recovery from tanker to compressor inlet	9.49E-08	8.254 E-08
IS7 R	Vapor recovery from tanker to compressor inlet	1.91E-06	2.22E-06
IS8 L	LPG vapor from compressor discharge to bullet inlet	4.03E-08	4.03E-08
IS8 R	LPG vapor from compressor discharge to bullet inlet	1.39E-09	1.02E-09
IS 9L	Unloading arm	4.89E-06	4.03E-06
IS9 R	Unloading arm	4.42E-06	4.40E-06
IS10 L	Main evacuation hose leak	3.20E-05	3.29E-05

7.2.12 Risk Acceptance Criteria

In India, there is yet to define Risk acceptance Criteria. However, in IS 15656 – Code of Practice for Hazard Identification and Risk Analysis, the risk criteria adopted in some countries are shown. Extracts for the same is presented below:

Table 7.10: Risk Criteria

Authority and Application	Maximum Tolerable Risk (per year)	Negligible Risk (per year)
VROM, The Netherlands (New)	1.0E-6	1.0E-8
VROM, The Netherlands (existing)	1.0E-5	1.0E-8
HSE, UK (existing-hazardous industry)	1.0E-4	1.0E-6
HSE, UK (New nuclear power station)	1.0E-5	1.0E-6
HSE, UK (Substance transport)	1.0E-4	1.0E-6
HSE, UK (New housing near plants)	3.0E-6	3.0E-7
Hong Kong Government (New plants)	1.0E-5	Not used

7.2.13 ALARP

To achieve the above risk acceptance criteria, ALARP principle was followed while suggesting risk reduction recommendations.

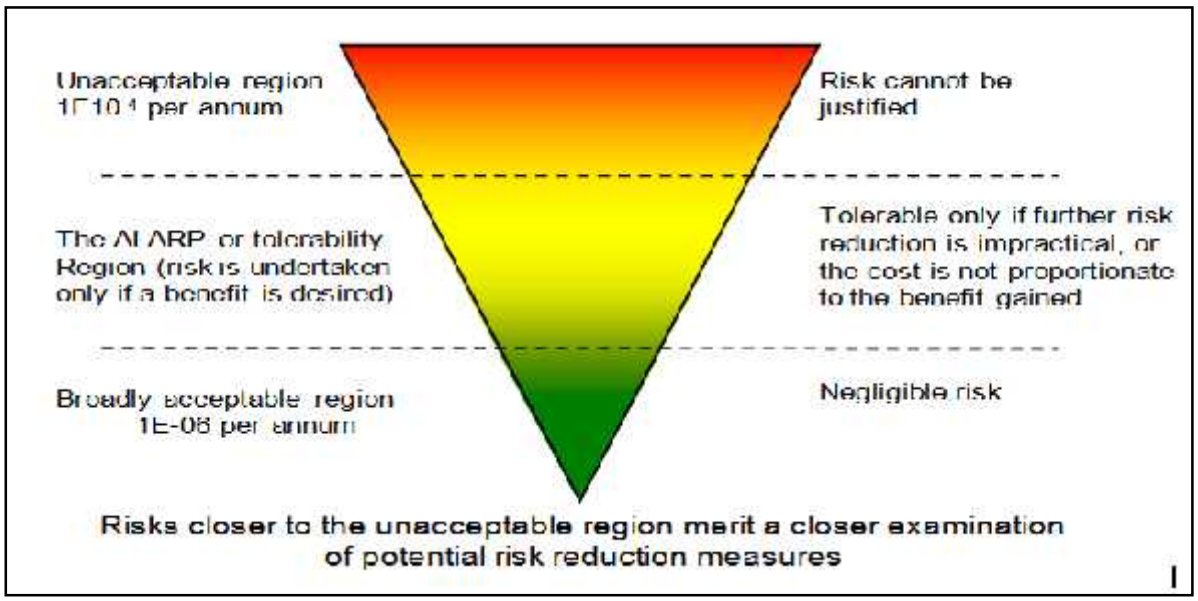


Figure 7.2: ALARP

As per the risk acceptance criteria, the risk (IR) of IOCL, Salem LPG Bottling Plant falls in ALARPregion.

7.2.14 Recommendations

Based on the information provided to Ultra - Tech team and the outcome of the QRA report, it is inferred that present risk levels posed by Salem-LPG Bottling Plant is in ALARP region.

Thus it is suggested to implement "Additional risk control measures" along with "risk control measures already proposed in the plant" for bringing down the risk level to Acceptable from ALARP level.

As per Consequence analysis maximum damage is caused by rupture of LPG liquid line from the tanker to bullet.

To reduce the effect of above scenario, effective additional measures are recommended as under:

1. Safety interlocks systems for pumps, compressors, bullets to be verified, counterchecked to make sure proper operation in the event of any failures

2. Gas detectors should be appropriately located, to identify the gas leaks as quick as possibleHydrocarbon /Fire detectors liked to ESD to minimize the release duration to contain LFL contour

3. Ensure elimination of all the ignition sources by provision of flame proof electrical fittings as per hazardous area classification, and also by incorporating operational controls by

prohibiting use of spark generating equipment such as mobile phone/camera. All the tools and tackles used in this area shall be spark proof.

4. LPG tankers only be fitted with spark arrestors shall allowed gas farm.

5. Operation and maintenance personnel shall be adequately trained and qualified for unloading of LPG tankers and operation of the facility.

6. Operation checklist in local language and English to be provided near operation area

7. It is suggested to have regular patrolling with critical parameters logging in order to prevent untoward incidents

8. Procedures to verify the testing & inspection records of the LPG tanker at the entry gate shall be developed. Vehicle speed limit within the Gas farm shall be restricted to the maximum of 20 km/hr.

9. Pipeline corridors and unloading area shall be protected with adequate crash barrier to prevent any accidental impacts / Vehicle movement.

10. Temporary stoppers (wheel chock's) to the wheel must be provided for the tanker to prevent rolling or sudden movement of the tanker. Wooden stoppers shall be used to prevent generation of spark.

11. Unauthorized entry into the facility shall be prohibited. Entry and exit shall be strictly controlled

12. The TREM (Transport Emergency) card should be available in the LPG tanker so that in case of any spillage or leakage from the tanker during transit or on road suitable emergency aid becomes easier.

13. Minimize the number trucks in TLD area to reduce the risk

14. Supervision over road tanker unloading activity

The above scenario shall be used as a base for developing plan for emergency actions.

7.2.15 Reference

- Reference Manual Bevi Risk Assessments version 3.2 , Netherlands
- CPR 18E – Committee for Prevention of Disasters, Netherlands
- A guide to Chemical Process Quantitative Risk Analysis – Centre for Chemical Process Safety
- DNV GL, PHAST-RISK (Safeti), Version 6.7,
- http://www.dnv.com/services/software/products/safeti/safeti/index.asp

- Buncefield Major Incident Investigation Board, “The Buncefield Incident 11 December 2005,The Final Report of the Major Incident Investigation Board”, December 2008
- International Association of Oil & Gas Producers, “OGP Risk Assessment Data Directory; Storage Incident Frequencies”, Report No. 434-3, March 2010.
- Census 2011

CHAPTER 8. ENVIRONMENT MANAGEMENT PLAN

8.1 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.

8.2 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.

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.

8.2.1 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 have valid PUC certitifcate.
- The storage and handling of soil, sub-soils, top-soils and materials will be carefully managed to minimize the risk of wind blown 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 CPCB.

8.2.2 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 CPCB set standards

8.2.3 Water Environment

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

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 STP .
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.

8.2.4 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.

8.2.5 Biological Environment

The region does not have dense vegetation and landuse is dominated by agriculture activities. Following environemtnal managemenr 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.

8.2.6 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.

8.2.7 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.

8.3 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:

8.3.1 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 (CPCB norms) for DG Sets to ensure adequate dispersal of pollutants will be provided.
- Waste Lube oil will not be incinerated and will be sold to MoEF/TNPCB authorised waste oil recyclers
- All access roads (internal as well as external) to be used by the project authorities will be paved (either with WBM, concrete or bitumen) to suppress the dust generation along the roads

8.3.2 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, DG 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.

8.3.3 Water Environment

- For domestic sewage, Septic Tank and Soak Pit 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 are as follows:
    - ✓ Sanitary waste water from toilets, wash-rooms and canteen.
    - ✓ Non-sanitary waste water from mock drills.

8.3.4 Land Environment

- 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 hazardous waste will be generated in the operation of LPG Bottling Plant.

8.3.5 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.

8.3.6 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:

- IOCL 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 villages around the facility
- Focus shall be on to educate villagers regarding safety measure provided in the plant.

8.4 Environmental Monitoring Programme

Introduction

Environmental 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 8.1.**

Table 8.1: 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 TNPCB consents
	Stack monitoring of DG Set	Once in three months	PM_{10}, $PM_{2.5}$,SO_2, NO_x, CO and other parameters as specified by TNPCB consents
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 and records of their dispatch to suppliers for refilling	As & when required	--
Environmental Audit	Environmental statement under the EP (Act) 1986	Once in a year	--

8.4.1 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 7.1.

8.4.2 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.

8.4.3 Noise Level

Ambient noise levels have been monitored at 10 stations inside and outside the plant in January 1, 2016 to March 31, 2016 seasons for day time and night time Leq.

8.5 Environmental Management Cell

The Locattion-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. As part of company's endeavor, the IOCL has been accredited with national and international certification of repute such as ISO: 14001 and ISO: 9002. Under this following aspects are covered.

- Reviewing the whole operation of LPG Bottling Plant, once in every two years, to identify the environmental aspects.

- Following the changes/amendments to central/state 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 approved by TNPCB.

8.6 Budgetary Allocation for Environmental Protection Measures

IOCL has proposed a capital investment of Rs.15 crores and a recurring cost of Rs. 1.50 crores per annum for environmental protection measures. The details of investment for procuring the equipment for efficient control and monitoring of pollution along with annual recurring cost are given in **Table 8.2**.

Table 8.2: Cost of Environmental Protection Measures

Sr. No.	Particulars	Proposed Cost (Rs. Crores)
1	Dust suppression	0.40
2	Water quality monitoring & management	0.25
3	Air quality and Noise monitoring	0.50
4	Greenbelt / Plantation	0.35
	Total	**1.50**

CHAPTER 9. DISCLOSURE OF CONSULTANTS ENGAGED

9.1 Consultants Engaged

This EIA report is prepared on behalf of the proponents, taking inputs from proponent's office staff, their R and D wing, Architects, Project Management Professionals etc. by Environmental Consultants **M/s. Ultra-Tech Environmental Consultancy and Laboratory, Thane**.

M/s Ultra-Tech Environmental Consultancy and Laboratory:

Ultra-Tech Environmental Consultancy and Laboratory [Lab Gazetted by MoEF – Govt. of India] not only give environmental solutions for sustainable development, but make sure that they are economically feasible. With innovative ideas and impact mitigation measures offered, make them distinguished in environmental consulting business. The completion of tasks in record time is the key feature of Ultra-Tech. A team of more than hundred environmental brigadiers consists of engineers, experts, ecologists, hydrologists, geologists, socio-economic experts, solid waste and hazard waste experts apart from environmental media sampling and monitoring experts and management experts , strive hard to serve the clients with up to mark and best services.

Ultra-Tech offers environmental consultancy services to assist its clients to obtain environmental clearance for their large buildings, construction, CRZ, SEZ, high rise buildings, township projects and industries covering sugar and distilleries from respective authorities.

Ultra-Tech also provide STP/ETP/WTP project consultancy on turn-key basis apart from Operation and Maintenance of these projects on annual contract basis. Also, having MoEF approved environmental laboratory, Ultra-Tech provide laboratory services for monitoring and analysis of various environmental media like air, water, waste water, stack, noise and meteorological data to its clients all over India and abroad.

The EIA team involved for the proposed EIA Report is as mentioned in **Table 9.1.**

Table 9.1: EIA Team

SN	Name of the expert	Area of functional Expert(NABET Accredited)
1	Mr. Santosh Gupta Mr. Timir Shah	EIA Coordinator Associate Team Member
2	Mr. Timir Shah	Air Pollution
2	Mr. Timir Shah	Water Pollution
3	Mr. Santosh Gupta Mr. Harsh Natu	Solid Hazardous Waste Associate Team Member
5	Dr. T. K. Ghosh	Ecology and Biodiversity

6	Dr. Kishore Wankhede	Socio Economic
7	Mr. Harsh Natu Mr.Ajay Patil Ms. Tejasvita Misra	Team Member

Functional area experts and assistance to FAE involved in the EIA study for "M/s.Indian Oil Corporation Ltd." is as shown in **Table 9.2**:

Table 9.2: Functional Area Experts Involved in the EIA

S.N.	NAME OF SECTOR	NAME OF PROJECT	NAME OF CLIENT	FUNCTIONAL AREA EXPERTS INVOLVED	
				FA	NAME/S
1.	Schedule 6 (b) Category 'B'	Isolated storage and handling of hazardous chemicals	M/s.Indian Oil Corporation Limited.	AP	Mr. Timir Shah
				WP	Mr. Timir Shah
					Associate: Mr.Ajay Patil
				EB	Dr. T. K. Ghosh
					Associate: Ms.Bharti Khairnar
				SE	Dr. Kishore Wankhede
				SHW	Mr. Santosh Gupta
					Associate: Mrs.DeepaTamhane – Karnik
				LU	Mr. Swapnil Avghade
					Associate: Mr. Prasad Khedkar
				RH	Dr.Ravindra Kode
					Associate: Mr. Ajay Patil

9.2 Laboratory for Analysis

NAME OF LABORATORY	SCOPE OF SERVICES	ACCREDITATION STATUS
M/s Eco Services India Pvt. Ltd.	**Monitoring and Analysis of:** • Ambient Air Monitoring • Stack Emission Monitoring • Bore Water(Analysis) • Domestic and Potable Water(Analysis) • Waste Water(Analysis)	Accreditated by NABL Valid upto 01.05.2017