

ENVIRONMENTAL IMPACT ASSESSMENT

FOR

THE PROPOSED SULPHONATION PLANT WITH THE PRODUCTION
CAPACITY OF 72 TPD OF LABSA

BY

M/s. Power Soaps Private Limited

AT

Pondicherry Industrial Promotion Development & Investment Corporation
Limited (PIPDIC) Industrial Estate, Sedarapet,
Villianur Commune Panchayat, Pondicherry district, Puducherry

REPORT FOR PUBLIC HEARING



Project Proponent
M/s. Power Soaps Pvt. Ltd.
Puducherry



EIA Consultant
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Hyderabad / Coimbatore
QCI/NABET Accredited EIA Consultant

JANUARY 2017

PREFACE

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POWER SOAPS PRIVATE LIMITED **Puducherry**

ENVIRONMENTAL IMPACT ASSESSMENT

FOR

THE PROPOSED SULPHONATION PLANT

**AT PIPDIC INDUSTRIAL ESTATE, SEDARAPET, VILLIANUR COMMUNE
PANCHAYAT, PONDICHERRY DISTRICT, PUDUCHERRY, INDIA**

For and on behalf of **VIMTA LABS LIMITED**

Approved by : Bh. Durga Bhavani

Signed :



Vimta
Driven by Quality. Inspired by Science.

Designation : **EIA Co-ordinator**

Date : 2017/01/28

This EIA report has been prepared in-line with TOR conditions stated by MoEF&CC vide letter no. J-11011/32/2016-IA II(I) dated 11.05.2016.

This report has been prepared by '**Vimta Labs Limited**' with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

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CHAPTER-1

INTRODUCTION

	Environmental Impact Assessment for the Proposed Sulphonation Plant (72 TPD of LABSA) by M/s. Power Soaps Private Limited at PIPDIC's Industrial Estate, Sedarapet, Puducherry Chapter – 1 Introduction

1.0 INTRODUCTION

M/s. Power Soaps Private Limited (PSPL) proposes a manufacturing unit to synthesize Linear Alkyl Benzene Sulphonic Acid (LABSA) at Plot nos. B – 41, 42, 43, 44, 45, 46, 47, 59, 60, 61, 62, 63, 64 & 65, Pondicherry Industrial Promotion Development & Investment Corporation Limited (PIPDIC) Industrial Estate, Sedarapet, Villianur Commune Panchayat, Pondicherry District, Puducherry. Power Soaps intends to produce 72 TPD (18,000 TPA) of 96% Linear Alkyl Benzene Sulphonic Acid (LABSA) using Linear Alkyl Benzene (LAB) and Sulphuric Acid.

In order to obtain Environmental Clearance from Ministry of Environment, Forest and Climate Change (MOEF&CC), Environmental Impact Assessment (EIA) report with detailed Environmental Management Plan (EMP) is essential as per the EIA notification and its subsequent amendments.

As per the EIA Notification dated 14th September 2006, the proposed project is classified as “**Category-A**” and falls under the following Schedule No: 5(f)-Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates).

The project was presented in the 6th Expert Appraisal Committee meeting held on 01.04.2016 and received TOR vide letter No. J-11011/32/2016-IA II(I) dated 11.05.2016 and the EIA report has been prepared inline with the TOR conditions obtained.

1.1 Identification of Project & Project Proponent

1.1.1 Project

Power Soaps proposes to manufacture LABSA (Acid slurry) using LAB (Linear Alkyl Benzene) and sulphuric acid. The concentration of the LABSA produced using above process is 96% and the production capacity is 72 TPD. The proposed process is based on use of the state of art SO₃ sulphonation technology using multi tube reactor. The estimated total project cost for the proposed project is INR. 575 Lakhs.

1.1.2 Project Proponent

Power Soaps Private Limited is one of the leading detergent manufacturing companies in South India which produces the range of Power products. Power products entered the Indian market in the 70's and quickly grabbed a major chunk of the business and now it has become a beloved household name in Tamilnadu, Kerala, Karnataka and Andhra Pradesh.

Power Soaps has world class manufacturing facilities located at Sembiapalayam, Gummudipoondi, Periyapalayan, Silvassa and Karaikal. The entire production cycle from intake of raw material, processing, manufacturing, quality checks and rollout of the product is carried out seamlessly. To increase the production quantity of LABSA, Power Soaps proposes a new manufacturing unit at Sedarapet, Puducherry.

The Power Soaps group began with a single unit at Kodai Road, Dindigul District, Tamil Nadu without compromising on quality. In 1998, detergent powder was introduced which turned out to be an extremely successful venture. Three more manufacturing units viz.

Narmadha Chemicals at Puducherry, Abirami Soap Works, Puducherry and Praveen Chem Industry at Karaikal were added to meet the increasing demand for power products. Today the company has ventured into the personal care Industry too with a range of hair and skin care products like the Nature Power range of shampoos and beauty soaps, LA Fairness Cream & LA Talc. The company is driven by a corset of values-commitment, integrity, excellence, unity, responsibility and understanding.

1.2 Brief Description of the Project

1.2.1 Size of the Project

The proposed project will have a production capacity of 72 TPD (18,000 TPA) of Linear Alkyl Benzene Sulphonic Acid (LABSA).

1.2.2 Location of the Project

The proposed plant site is located in PIPDIC industrial estate of Sedarapet village, Villianur Commune Panchayat, Pondicherry district, Puducherry. PIPDIC handed over land of 0.907 Ha for sulphonation plant. The proposed site lies in Latitude 12° 00' 08.61" N and Longitude 79° 45' 25" E. The entire area falls in Survey of India Topo Sheet Nos. 57 M/9, M/13, P/12 & P/16. The nearest highway is National Highway-66 connecting Puducherry-Thindivanam-Thiruvannamalai which is located at 3.3 km in East direction. Also the site is located at about 11.7 km, SE from Puducherry City and 0.7 km from Sedarapet village. The nearest railway station is Villianur R.S., which is at a distance of about 9.2 km in South direction. The nearest airport is Pondicherry Airport (7.3 km, SE).

The details of environmental setting are given in **Table-1.1**. The index map and study area of 10 km radius of the proposed project is shown in **Figure-1.1** and **Figure-1.2**. The aerial view and site photographs of the proposed project is shown in **Figure-1.3** and **Figure-1.4** respectively

1.2.3 Importance to the Country and Region

The demand for the detergents cakes and powders are increasing due to the increasing population and their literacy rate which pushes them towards choosing the best quality consumer products. The use of Linear Alkyl Benzene Sulphonic Acid (LABSA) in the detergent manufacturing units have substantial demand in the country and also has export potential. The proposed plant will fulfil the demand for the LABSA directly and the demand of detergents indirectly. The products of the proposed plant will also be exported, which will attract valuable Foreign Exchange. The proposed project will help reducing the gap between demand and supply of high concentrate LABSA.

TABLE - 1.1
ENVIRONMENTAL SETTING OF THE PROPOSED PROJECT SITE (10 KM RADIUS)

Sr. No.	Particulars	Details		
		Corner	Latitude	Longitude
1.	Site – coordinates & elevation	A	12° 00' 10.19"	79° 45' 19.21"
		B	12° 00' 09.91"	79° 45' 21.72"
		C	12° 00' 06.50"	79° 45' 20.63"
		D	12° 00' 07.43"	79° 45' 18.07"
2.	Elevation	40 m Above Mean Sea Level (AMSL)		
3.	Climatic conditions (Based on IMD, Cuddalore)	Annual Mean Max Temp: 37.1 ⁰ C (Summer) Annual Mean Min Temp : 20.6 ⁰ C (Winter) Annual Total Rainfall : 1298.4 mm		
4.	Land use of the project site	Industrial land (PIPDIC Industrial Estate, Puducherry)		
5.	Nearest Highway	NH 66 – 3.3 km, East		
6.	Nearest Railway station	Villianur R.S. - 9.2 km, South		
7.	Nearest Air Port	Pondicherry – 7.3 km, SE		
8.	Nearest Habitation	Sedarapet – 0.7 km, WSW Acharampattu - 1.4 km, ENE Akasampattu - 1.4 km, North Panjavadi - 1.8 km, NE Puducherry - 11.7 km, SE		
9.	Surface water bodies	Turuvai lake - 2.2 km, North Ousudu lake - 3.2 km, South Pulichapallam lake - 3.4 km, North Katrambakkam lake - 5.0 km, North Katterikuppam lake - 6.0 km, West Kodur lake - 6.6 km, NE Pambai river - 8.8 km, SW Gingee river - 9.0 km, SSW Kaliveli lake - 10.1 km, NE Bay of Bengal - 10.3 km, ESE Velrampet lake - 11.2 km, SE Thengaithittu Estuary - 12.9 km, SE Chunnambar river - 14.1 km, SE		
10.	Nearest Sea Port	Chennai port – 134.1 km, NE		
11.	Seismicity	Seismic Zone – II (Zone Factor, Z as 0.10) as per IS:1893-2002		
12.	Hills/Valley	Nil in 10-km radius		
13.	Archaeologically important places	Nil in 10-km radius		
14.	Ecologically sensitive zones like Wild Life Sanctuaries, National Parks & biospheres	Ousudu bird sanctuary - 3.2 km, South		
15.	Reserve Forest /protected Forest	Ousudu bird sanctuary - 3.2 km, South		
16.	Defence Installations	Nil in 10-km radius		
17.	Socio-economic factors	No resettlement and rehabilitation involved		



Environmental Impact Assessment for the Proposed Sulphonation Plant (72 TPD of LABSA) by M/s. Power Soaps Private Limited at PIPDIC's Industrial Estate, Sedarapet, Puducherry

**Chapter – 1
Introduction**



**FIGURE – 1.1
INDEX MAP OF THE PROJECT SITE**

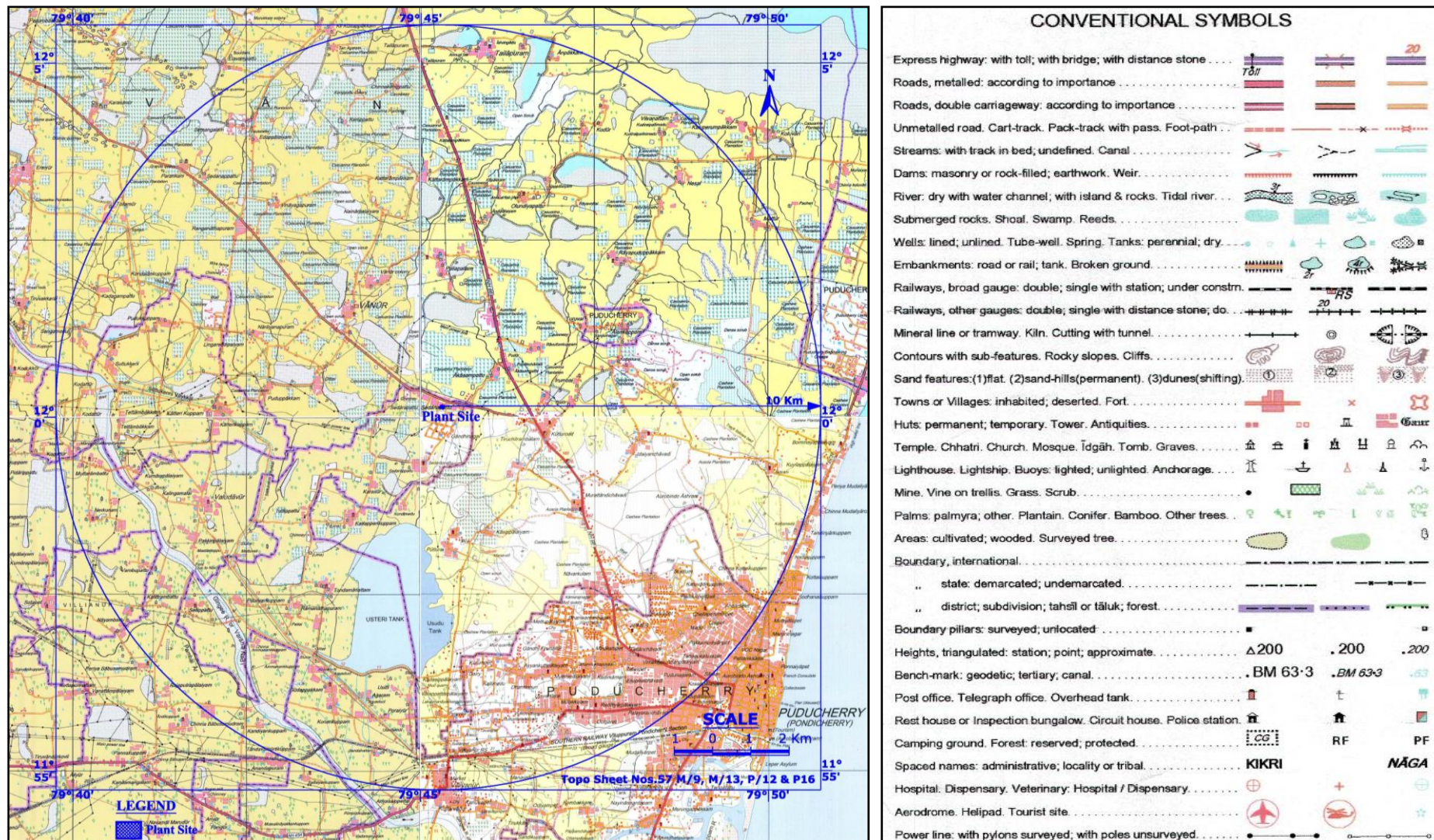


FIGURE – 1.2

STUDY AREA MAP – 10 KM RADIUS

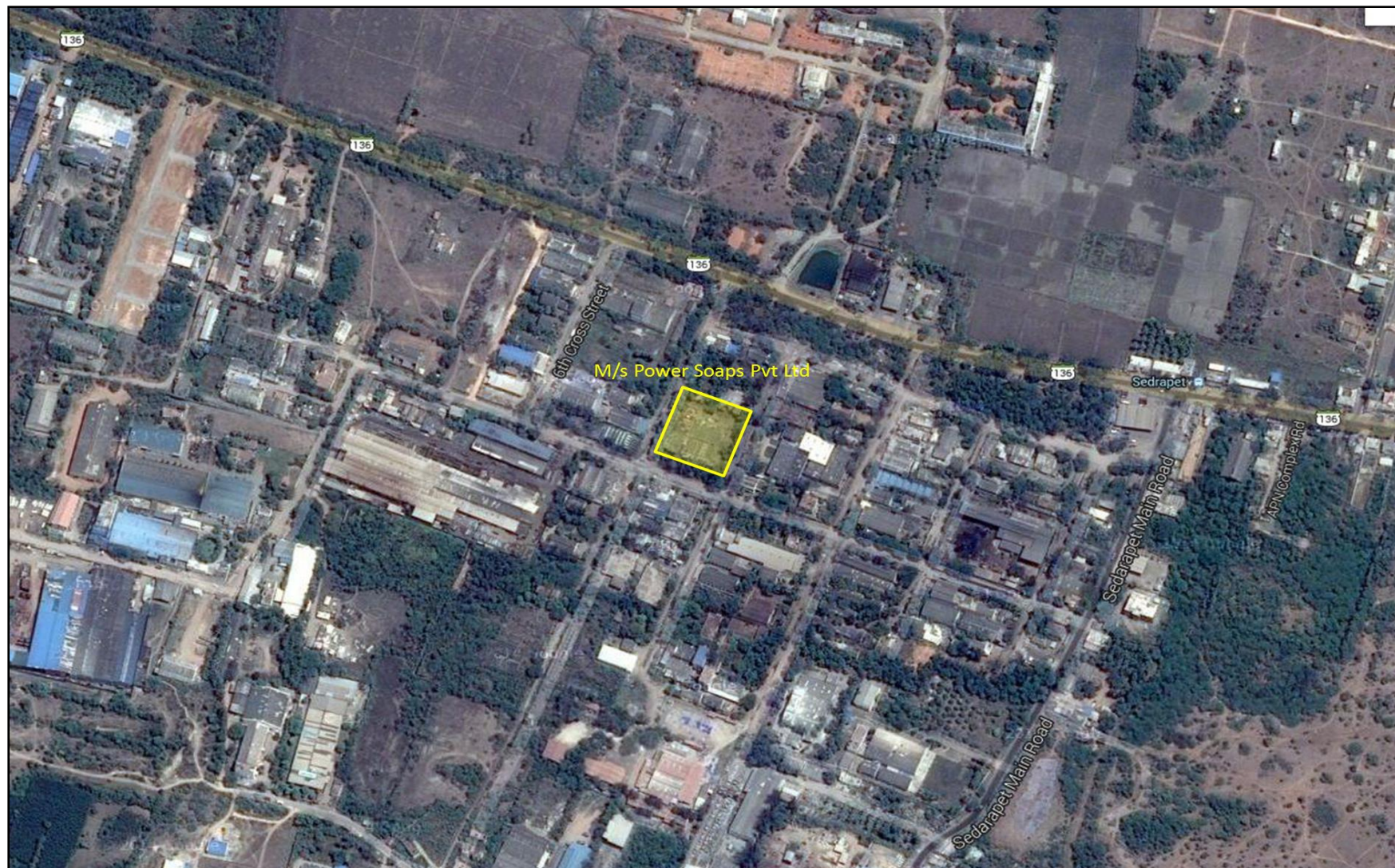


FIGURE – 1.3

AERIAL VIEW OF THE PROPOSED PLANT SITE



EAST DIRECTION



WEST DIRECTION



NORTH DIRECTION



SOUTH DIRECTION

FIGURE – 1.4

SITE PHOTOGRAPHS OF THE PROPOSED PLANT SITE

1.3 Scope of the Study

The scope of this study broadly includes:

- Field sampling of environmental attributes at various representative locations in the study area to establish the baseline environmental status;
- Collate and compile secondary data including socio-economic data from published literature/government publications;
- Estimate pollution loads that would be generated by the proposed project;
- Predict incremental levels of pollutants in the study area due to the proposed project;
- Evaluating the predicted impacts on the various environmental attributes by using scientifically developed and widely accepted Environmental Impact Assessment Modelling Methodologies;
- To Prepare an Environmental Management Plan (EMP) to mitigate the predicted impacts; and
- Identify critical environmental attributes that are required to be monitored during the project execution and to suggest post project monitoring.

This EIA report addresses the environmental impacts of the proposed LABSA manufacturing plant in addition to the findings of the Risk Analysis (RA) study and the On-site Disaster Management Plan (DMP).

1.4 Methodology of the Study

Fresh baseline studies have been conducted during 01st April to 30th June 2016 to determine existing conditions of various environmental attributes as outlined in **Table-1.2**.

TABLE-1.2
ENVIRONMENTAL ATTRIBUTES AND FREQUENCY OF MONITORING

Sr. No.	Attributes	Parameters	Frequency
1.	Ambient Air Quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO, NH ₃ , C ₆ H ₆ , B(a)P, O ₃ , Pb, As, Ni, HC & VOCs	24 hourly samples twice a week for three months at 6 locations
2.	Meteorology	Wind speed and direction, Temperature, Relative humidity and Rainfall	At plant site, continuous for three months with hourly recording and data also collected from secondary sources like IMD station at Cuddalore
3.	Water quality	Physical, Chemical and Bacteriological parameters at 6 ground water and 2 surface water locations	Grab samples were collected once during study period
4.	Noise levels	Noise levels in dB(A)	Once during study period at 8 locations
5.	Soil Characteristics	Parameters related to agricultural and afforestation potential	Once during study period at 6 locations

Sr. No.	Attributes	Parameters	Frequency
6.	Traffic Survey	Vehicle count	Once during study period
7.	Land use	Trend of land use change for different categories	Based on data published in District Census Handbooks (2011)
8.	Ecology	Terrestrial and aquatic flora and fauna in 10-km radius circle	Through field studies once during study period
9.	Socio-Economic aspects	Socio-economic characteristics, labour force characteristics	Based on data collected from secondary sources like primary census abstracts of Census of India 2011
10.	Geology	Geological history	Hydro-geological data based on data collected from secondary sources
11.	Risk Assessment and DMP	Identify areas where disaster can occur by fires and explosions and release of toxic substances	Risk assessment and modeling

1.5 Organization of the Report

The proposed project would naturally have implications on the neighbourhood with reference to socio-economic aspects of society, environmental attributes such as land, water, air, aesthetics, flora and fauna. In assessing the environmental impact, collection, collation and interpretation of baseline data is of prime importance. Environmental impact analysis and assessment which is required for every industrial project should preferably be carried out at the planning stage itself.

The basic objective of identification of impacts is to aid the proponents of the project to rationalize the procedure for an effective environment management plan, leading to an improvement in environmental quality as a result of the location of the proposed Project. This has been attempted by the following procedure:

- Collection, collation and analysis of baseline data for various environmental attributes;
- Identification of impacts;
- Impact assessment through modeling;
- Evaluation of impacts leading to preparation of environment management plan; and
- Outlining post project monitoring methodology.

CHAPTER-2

PROJECT DESCRIPTION

	<i>Environmental Impact Assessment for the Proposed Sulphonation Plant (72 TPD of LABSA) by M/s. Power Soaps Private Limited at PIPDIC's Industrial Estate, Sedarapet, Puducherry</i> <i>Chapter-2</i> <i>Project Description</i>

2.0 PROJECT DESCRIPTION

This chapter presents the type, need, location & size of the project, major resources required for proposed project, project schedule, technological consideration, process / technical description and likely environmental effects due to the proposed project and mitigation measures to be adopted.

2.1 Type of Project

The proposed project of Power Soaps Private Limited is sulphonation of Linear Alkyl Benzene (LAB) to produce 72 TPD (18,000 TPA) of 96% Linear Alkyl Benzene Sulphonic Acid (LABSA). The major plant facilities proposed for the project are SO₃ Gas Plant, SO₃ Absorber System, Sulphonation System and Effluent Gas Treatment System.

2.2 Need for the Project

The use of Linear Alkyl Benzene Sulphonic Acid (LABSA) in the detergent manufacturing units has substantial demand in the country and has export potential also. The demand for the detergents cakes and powders are increasing due to the increasing population and their literacy rate. As the project proponents are operating 5 nos. of detergent manufacturing units, they require adequate quantity of LABSA.

To fulfil the increasing demand for LABSA in their detergent plants and to earn valuable foreign exchange, Power Soaps Private Limited proposes to install a new production facility and increase its overall production capacity.

2.3 Project Location & Layout

The project site is located in Plot nos. B - 41,42,43, 44, 45, 46, 47, 59, 60, 61, 62, 63, 64 & 65, PIPDIC's Industrial Estate, Sedarapet, Villianur Commune Panchayat, Pondicherry district, Puducherry. The overall plant layout and machineries layout showing the proposed plant facilities are given in **Figure-2.1** and **Figure-2.2**.

2.4 Size or Magnitude of Operation

The proposed production capacity of the plant will be 72 TPD (18,000 TPA). The total estimated cost of the proposed project is about INR. 575 Lakhs. The details of the resource requirements like land, raw materials, power, water and manpower for the proposed project is described in this section.

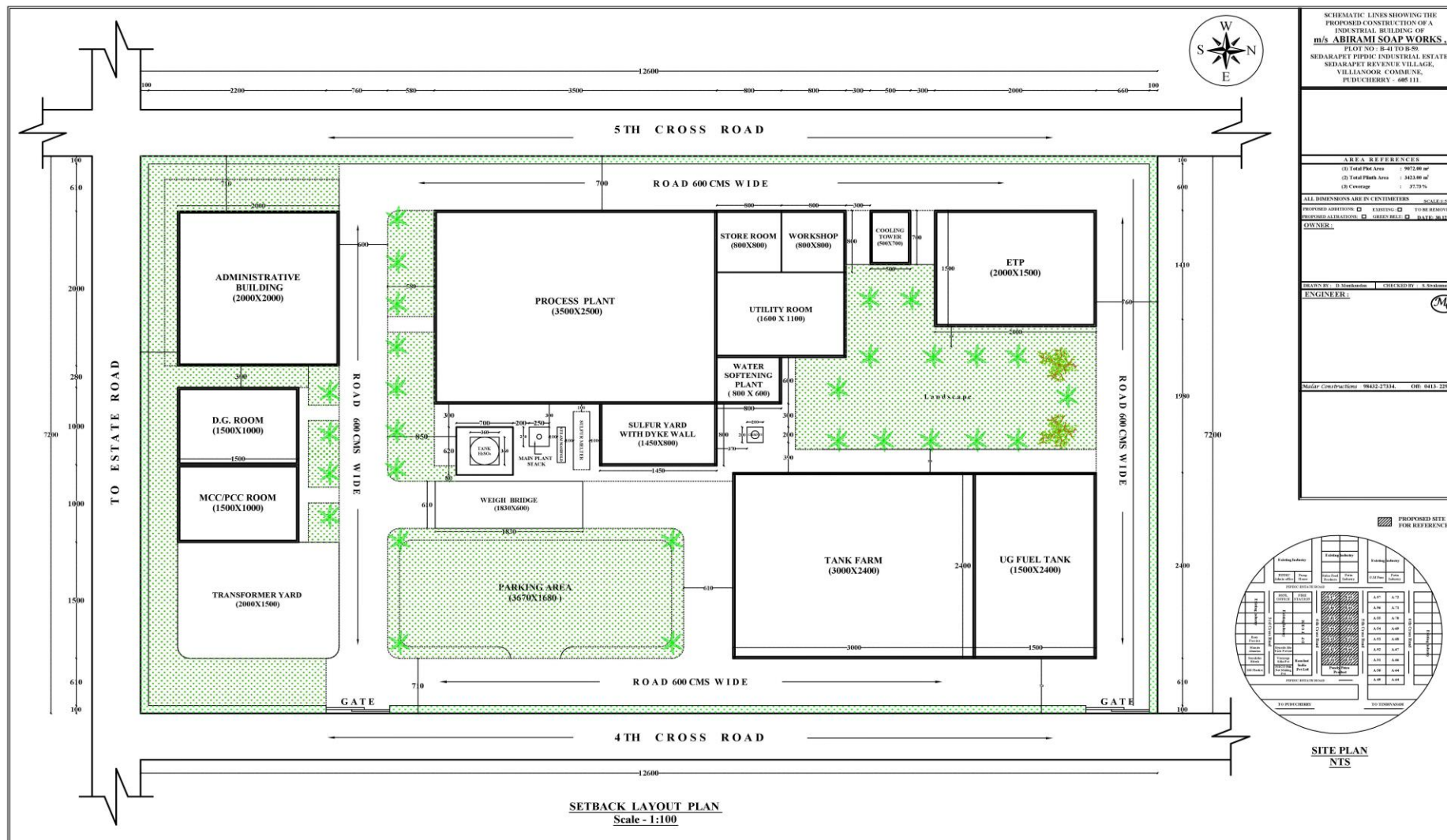


**FIGURE - 2.1
OVERALL PLANT LAYOUT**

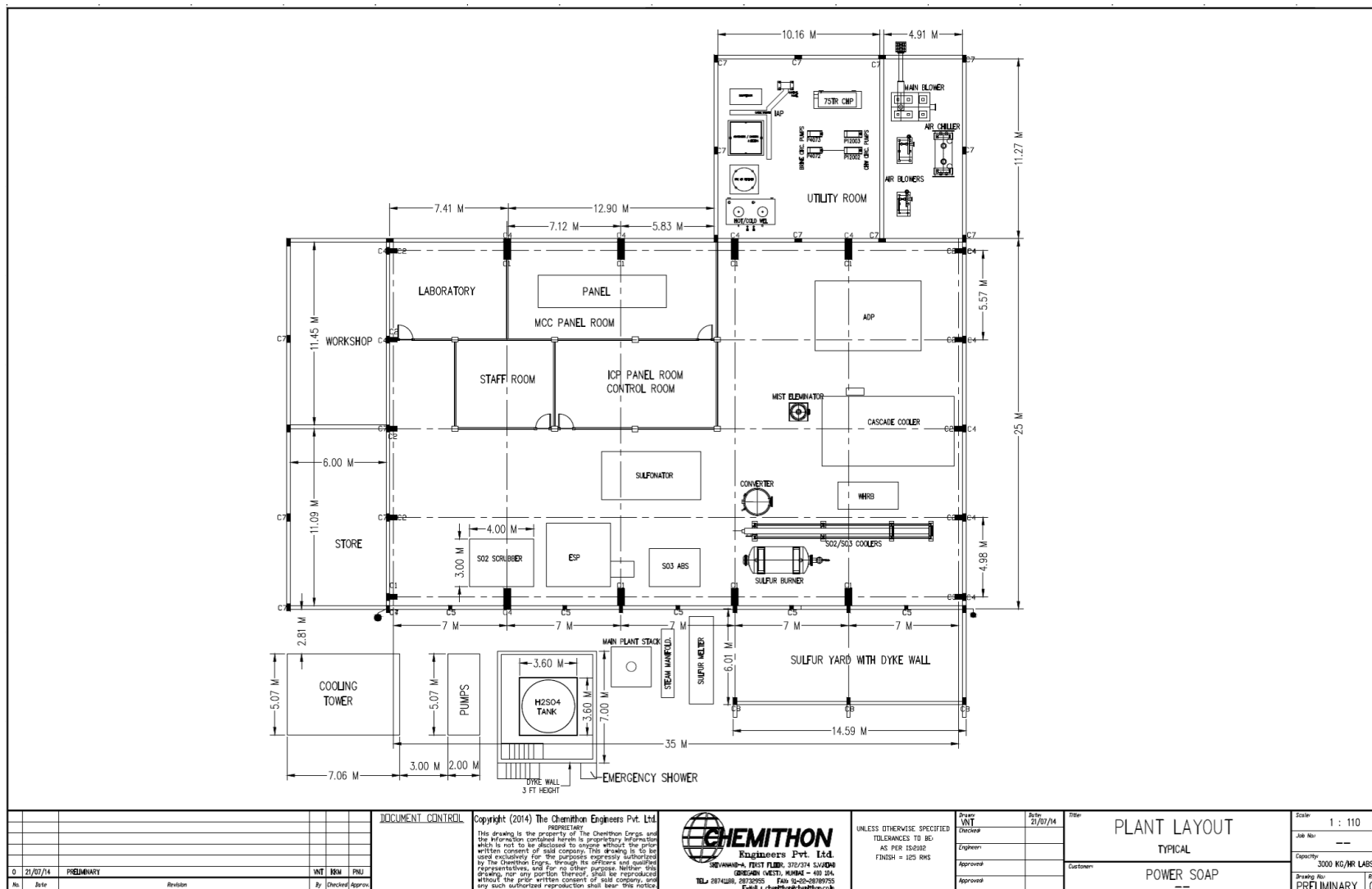


**FIGURE – 2.2
MACHINERIES LAYOUT**

2.4.1 Land Requirement

The total land allotted for the proposed plant at PIPDIC, Sedarapet is 0.907 ha (2.24 acres). The land is already an industrially specified area and thus there will not be much change in the present land use at the proposed plant site. The layout of the PIPDIC industrial estate indicating location of the proposed sulphonation plant is shown in **Figure-2.3**. The land use break-up details are given in **Table-2.1**.

TABLE-2.1
DETAILS OF LAND USE BREAK-UP

Sr. No.	Plant Facilities	Area (ha)	Percentage (%)
1.	Production facilities	0.234	25.80
2.	Storage Building & Tank farm	0.136	15.00
3.	Greenbelt development	0.250	27.56
4.	Open area	0.287	31.64
Total		0.907	100.0

Source: PSPL

2.4.2 Raw Material Requirement

The major raw materials required for the proposed sulphonation plant are Linear Alkyl Benzene and Sulphur. The sulphur will be stored in the sulphur yard storage with dyke wall area of 116.0 m². The annual requirement of various raw materials and their sources is given in **Table-2.2**.

TABLE-2.2
DETAILS OF RAW MATERIALS REQUIREMENT

Sr. No.	Material	Quantity	Source	Transportation	Storage Facility
Raw Material					
1.	Organic Alkylate	55.44 TPD	Chennai	By Road	Closed Steel Tank
2.	Sulphur	8.28 TPD	Jamnagar, Gujarat	By Road	Sulphur Yard Storage with Dyke Wall
Other Chemicals					
3.	Caustic Soda Lye	50 TPA	Tamil Nadu & Maharashtra	By Road	S. Steel Tank

Source: PSPL

2.4.3 Power and Fuel Requirement

The total power required for the proposed plant is about 900 KVA, which will be met from the state grid. To meet the emergency power requirement during the grid failure, a diesel generator set having capacity of 1000 KVA is proposed. The fuel required in the plant is only High Speed Diesel (HSD), which is used as fuel in generators. The requirement of HSD is about 250 lit/hr.

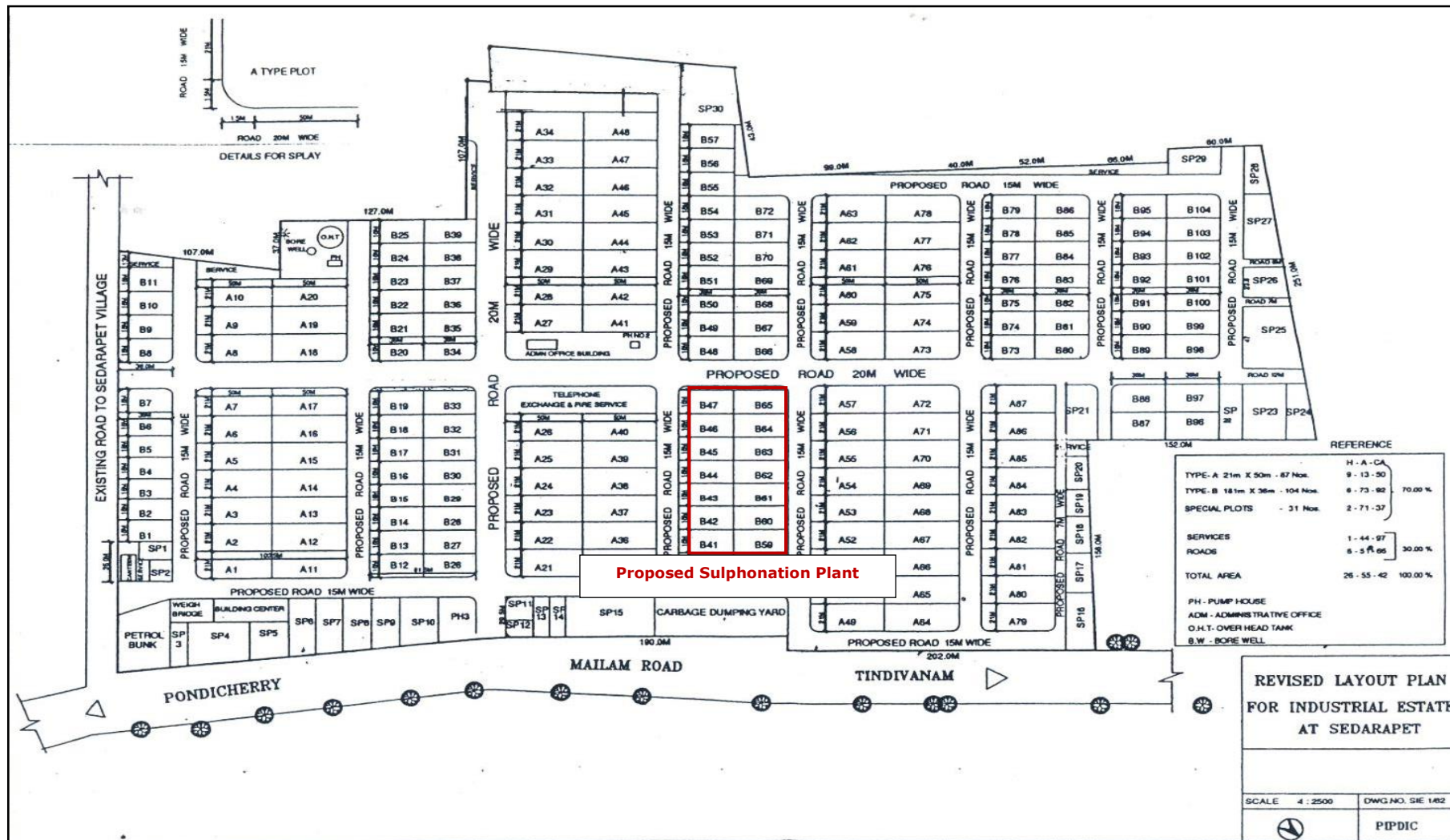


FIGURE-2.3
LAYOUT MAP OF THE PIPDIC INDUSTRIAL ESTATE



2.4.4 Water Requirement

The one time water requirement for the proposed project will be 48.5 KLD and the daily fresh water requirement will be 30.4 KLD. The domestic requirement of 1.5 KLD will be met from PIPDIC and for the industrial process requirement of 28.9 KLD the water will be met from the authorized private Supplier. The breakup of the estimated water requirement is presented in **Table-2.3**. The water balance is given in **Figure-2.4**.

**TABLE - 2.3
DETAILS OF WATER REQUIREMENT**

Sr. No.	Purposes	Quantity (KLD)
One Time Water Requirement		
1.	Cooling tower make-up	32.0
2.	Scrubber make-up	8.0
3.	Softener/Demineralization Plant	7.0
4.	Domestic Requirement	1.5
	One Time Water Requirement (A)	48.5
Recirculation / Reuse of treated water		
1.	Demineralization Plant (Recirculation)	6.1
2.	Cooling Tower Reuse	12.0
	Total Water Reused (B)	18.1
	Daily Freshwater Requirement (A-B)	30.4

2.4.5 Manpower Requirement

The manpower required for the proposed plant will be 35 nos., which includes manager, admin staffs, supervisor and workers.

2.5 Project Schedule for Approval and Implementation

The plant will be commissioned in a period of 12 months from the date of receipt of all the approvals from statutory authorities.

**TABLE - 2.4
PROJECT IMPLEMENTATION SCHEDULE**

Sr. No.	Activity	Time frame
1.	Preliminary design	1 st month
2.	Final design	2 nd month
3.	Purchasing	2 nd to 8 th month
4.	Fabrication	3 rd to 9 th month
5.	Despatches	6 th to 10 th month
6.	Installation	7 th to 11 th month
7.	Pre-commissioning	11 th month
8.	Commissioning start-up	12 th month

Source: PSPL

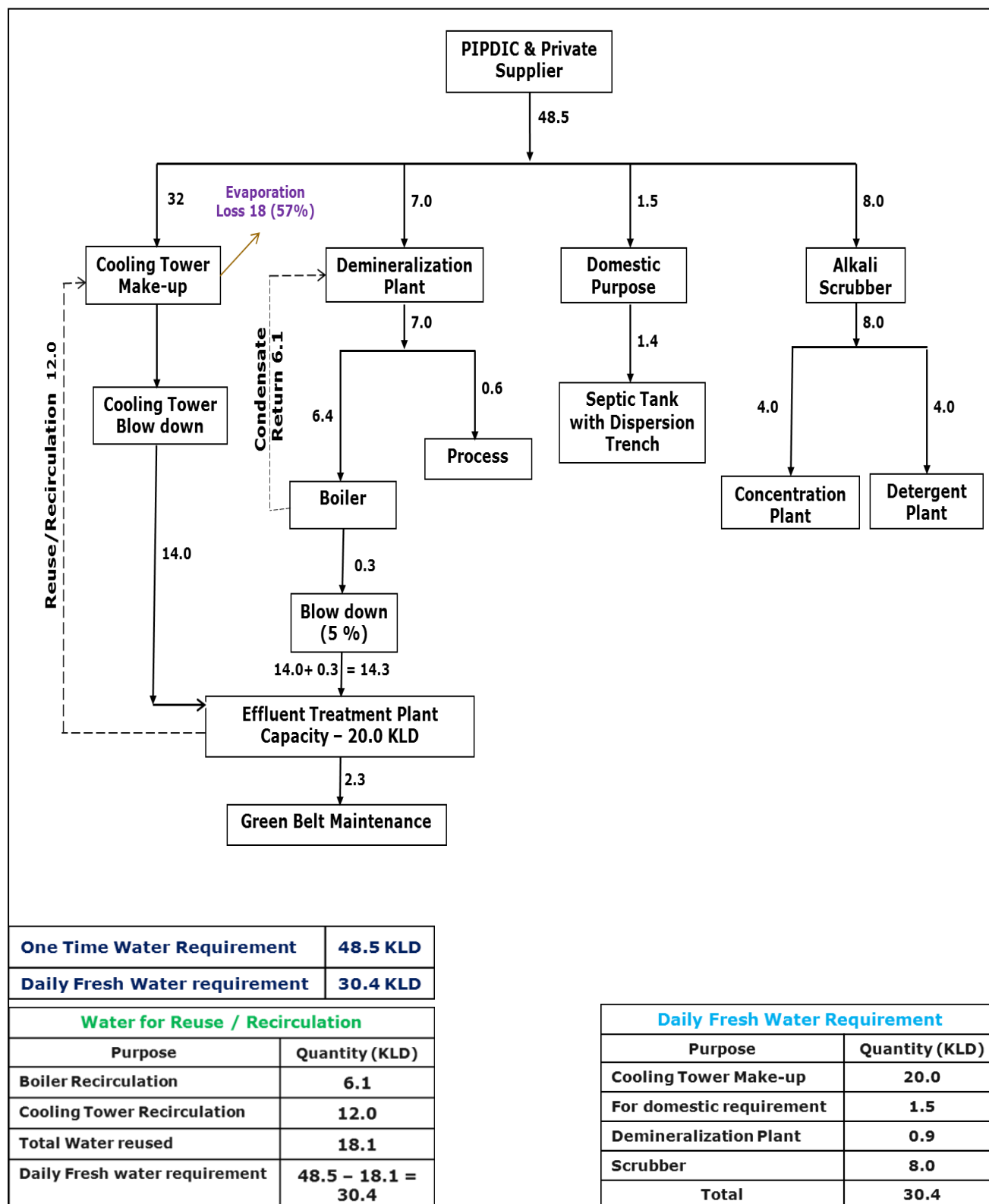


**FIGURE-2.4
WATER BALANCE**



2.6 Technology Adopted

The customary method of production starts with the appropriate alkyl benzene which is sulphonated and then subsequently neutralised. The sulphonation reaction can be carried out in various ways. In the past, the reaction was carried out using concentrated sulphuric acid or oleum, in either case using an excess of acid. At the end of the sulphonation, the surplus acid and the desired product must be separated. Alternatively the entire mixture can be neutralised leading to a product containing a substantial proportion of an inorganic sulphate salt, e.g. sodium sulphate.

Subsequently, it has become conventional to use sulphur trioxide as sulphonating agent. US patent 2928867 published in 1960 teaches that at the end of a sulphonation process carried out with sulphur trioxide, a small amount of water should be added to the reaction mixture to hydrolyse sulphonic acid anhydrides present in it so that a stable product is obtained after neutralisation.

During more recent years it has become standard practice to use gaseous sulphur trioxide as sulphonating agent in an approximately stoichiometric quantity, then age the resulting mixture during which time, the reaction mixture proceeds further towards completion, followed by the addition of a small quantity of water which is believed to hydrolyse any anhydrides present in the reaction mixture thereby stabilising reaction. This current practice is described in, for example, "Sulphonation Technology in the Detergent Industry" by W Herman de Groot, 1991. When carrying out this conventional practice the sulphur trioxide is normally diluted with some other gas which does not react. Air can be used for this purpose.

It is possible to carry out the reaction using an excess of sulphur trioxide but this leads to disadvantages. One disadvantage is the formation of coloured impurities. If a substantial excess of sulphur trioxide is used, the mixture obtained contains unwanted sulphuric acid which must be removed or tolerated as an impurity just as with the older processes using sulphuric acid or oleum. This is less of a problem if there is only a small excess of sulphur trioxide but, as will be explained further, this leads to the presence of undesirable impurities.

When sulphonation is carried out using an approximately stoichiometric quantity of sulphur trioxide it is found that the conventional ageing period at the end of the sulphonation reaction gives increased conversion of the alkyl benzene into the desired sulphonic acid. Nevertheless, it is observed that the alkyl benzene feedstock is not completely converted into the desired alkyl benzene sulphonic acid. A small percentage of alkyl benzene remains unchanged and a small quantity is converted into a sulphone of the formula.

The relative proportions of unconverted alkyl benzene and sulphone impurity vary. They are affected by the reaction conditions employed and by the mole ratio of sulphur trioxide to alkyl benzene. Although it is possible to vary the relative proportions of unreacted alkyl benzene and sulphone, it is not possible to avoid both of them simultaneously by control of reaction conditions or mole ratio of reactants. Thus, if the mole ratio of sulphur trioxide to alkyl benzene is increased so as to minimise the percentage of unconverted alkyl benzene, the percentage of sulphone increases.

Failure to convert alkyl benzene to sulphonic acid and conversion to by-product sulphone both represent a waste of alkyl benzene feedstock. Additionally, unconverted alkyl benzene can give rise to tower emission problems on spray drying and there have also been speculations that residual alkyl benzene is slightly toxic.



Thus, although the present commercial procedure of sulphonation with stoichiometric quantity of sulphur trioxide followed by ageing and then the addition of water to arrest the reaction is very advantageous compared with earlier processes in that it gives a high level of conversion to the desired product without introducing large quantities of sulphuric acid into the product mixture, there is still some scope for further improvement where it would be desirable to reduce further the combined levels of alkyl benzene and sulphone below what is currently achievable.

According to the present invention, there is a method of manufacturing alkyl benzene sulphonate by contacting, as reactants, alkyl benzene with sulphur trioxide using a molar ratio of alkyl benzene to sulphur trioxide in the range of 1:0.9 to 1:1.3, characterised by incorporating sulphuric acid into the reaction mixture after bringing the reactants into contact, the amount of sulphuric acid being not more than 10% by weight of the reaction mixture, and then allowing reaction in the mixture to continue for at least 30 minutes.

It has been found that by incorporating sulphuric acid in this manner it is possible to achieve an improvement in the overall conversion to the desired product and a consequent reduction in the undesired impurities. For carrying out this reaction, the sulphur trioxide is preferably diluted with another gas, as is conventional. This other gas may well be air. The ratio of sulphur trioxide to other gas may desirably lie in a range from 3% to 10% by volume. The molar ratio of alkyl benzene to sulphur trioxide is preferably in a range from 1:0.9 to 1:1 or better 1:0.95 to 1:1. The alkyl benzene which is sulphonated may have a straight or branched alkyl group which preferably contains around 10 to 15 carbon atoms. Although branched alkyl benzene has been extensively used for detergent manufacture it is nowadays usually preferred to employ linear alkyl benzene, that is to say alkyl benzene in which the alkyl group has a straight carbon chain.

2.7 Project Description

2.7.1 Sulphur Melter - Burner

Molten sulphur is supplied to the sulphur burner by a submersible pump from the sulphur melter. A steam and condensate system is utilized to supply the necessary tracing circuits for all the sulphur piping and sulphur melter.

The process air is first compressed to a pressure of approximately 1 kg/cm² and chilled to a temperature of 16°C in the air chiller vessel. The chilled air is then dried in automatic desiccant- type air dryers to a guaranteed dew point of 60°C.

The dual air dryers are equipped with 11 individual bubble tight control valves. This ensures absolutely no interruption of process air when changing dryers and a smooth pressure transition when changing to regeneration. On power failure, these valves are designed to automatically close to prevent back up of corrosive gas into the dryers, and to keep moist atmospheric air from reaching the dryers and gas plant. The cooling air blower supplies cool air to the regenerated (off-line) air dryer to reduce the bed temperature to an acceptable level, prior to bringing the regenerated air dryer back on-line.

A regeneration air blower is used to supply cooling air to the double pipe SO₂ gas cooler used in the gas plant. The hot air leaving the double pipe cooler is then used to regenerate the off-line air dryer. During the air dryer cooling cycle, the regeneration air is vented to the atmosphere.



The molten sulphur is delivered to the refractory-lined atomizing sulphur burner where combustion with the dry process air, generates sulphur dioxide (SO_2). The sulphur dioxide gas leaving the burner is cooled and delivered to a three-stage Vanadium oxide catalytic converter, where the gas is filtered and converted to sulphur trioxide (SO_3). An injection air system is used to cool the gas between the converter stages. When the conversion efficiency of the converter approaches 98%, the sulphur trioxide gas leaving the converter is cooled to nearly ambient temperature in a cascade cooler prior to entering the Brink-type inlet mist eliminator which removes traces of sulphuric acid or oleum. Heat recovered from the SO_2 and SO_3 coolers is used to regenerate the air dryers, thus eliminating the need for an external heat source. A Continuous source of dry air- SO_3 gas is required for film sulphonation and sulfation.

2.7.2 SO_3 Absorber System

Before burning of Sulphur, the converter catalyst is preheated to conversion temperature. Once temperature of about 380 °C is reached, sulphur is burned and conversion of SO_2 to SO_3 takes place within 30 minutes. However for safety purpose and to avoid air pollution, SO_3 absorption system is provided. The SO_3 absorber system offers a convenient and reliable method of handling the process gas during startups. The sulphonation system uses mole ratio from known sulphur and assumed SO_2 to SO_3 conversion efficiency to meter the organic to the reactor. Negligible amounts of off-spec (over or under sulfonated) products would be made if the sulphonation system was utilized, during gas plant startups.

The SO_3 absorber system also offers a convenient and reliable method of handling the process gas during plant shutdowns, upsets, and product changeovers when the sulphonation system must be fully drained and washed out. During plant shutdowns the sulphur is turned off but the residual gases in the gas plant vessels are best purged through the absorber to eliminate fouling in the sulphonation reactor and/or making off-spec product. During product changeovers the gas plant can be kept on-line (steady state) by utilizing the absorber system as an alternate path through the plant.

SO_3 and air enter the absorber column, where they contact 98% sulphuric acid. SO_3 is absorbed into the acid, which separates from the remaining air in the scrubber body. A mesh pad mist eliminator removes entrained mist from the air as it exits the vessel. Water is added to the scrubber as it flows through the acid circulation system. A control system utilizing dual conductivity sensors holds the acid concentration at 98% by controlling water addition. A heat exchange in the circulation loop removes heat of dilution.

2.7.3 Sulphonation System

The Sulfonic acid forms in the unit when an SO_3 -in-air mixture is injected into a multi-tube reactor, simultaneously with the desired organic feed. The removable organic distribution flanges are factory calibrated prior to installation in the reactor. Uniform distribution of the air- SO_3 gas is the result of symmetrical gas flow through the reactor.

Reaction temperature is also a very important parameter of control insulfonation and sulfation process. Cooling jackets in the reactor remove heat of reaction. Organic feed rate to the reactor vessels is measured by means of a highly accurate mass flow meter and controlled by a control valve and centrifugal pump. The organic feed rate is controlled based on the preset sulphur-to-organic mole ratio.

Exhaust gas is separated from the acid recycle stream in the liquid separator and cyclone vessels. For the production of sulfonic acid, the acid product is fed directly to the digestion



system where reaction with absorbed SO_3 goes to completion. The details of operating requirements are given in **Table-2.5**.

**TABLE-2.5
OPERATING REQUIREMENTS**

Sulfonation Plant		
Type of plant	-	Standard Sulfonation plant
SO_3 Gas concentration	-	5% SO_3
Capacity	-	3000 kg/hr LABSA (MW 320)
Equipment	-	Sulphur burner, Sulphur melter, SO_3 Gas generator, SO_3 absorber, Sulfonator with multi tube reactor, ESP and SO_2 scrubber
Basis of rated plant capacity		
Name of Organic feed	-	Linear Alkyl Benzene (LAB)
Mol. Wt. of Organic Feed	-	240
Molecular Weight of Product	-	342
Ambient Air conditions		
Relative Humidity	-	50% at 30°C (86°F)
Minimum Temperature	-	0°C (32°F)
Maximum Temperature	-	43°C (110°F)
Plant Elevation	-	40 m AMSL
Utilities*		
Electrical Power	-	230/415 +/- 27V, phase, 50 + 1 Hz
Connected	-	900 KW
Running	-	700 KW
Cooling water	-	300 m ³ /hr
Steam @ 10 kg/cm ²	-	300 Kg/hr Atomizing & Instrument Air
7 kg/cm ² (dew point less than 5°C)	-	150 Nm ³ /hr
* - The utility usage figures are typical for similar plant operation		

Control System

The Control system consists of three main components, which are integrated into a single system: Main instrument Control Panel, Motor Control Center, and ESP control panel. This system improves the operators understanding of plant operation through a graphic interface and improves product consistency and quality through better control.

Description of Gas purifying Machineries

❖ Candle Filter

To remove the traces of unabsorbed SO_3 gas, Candle filters are used where fresh LAB is sprayed from above to absorb the gas. The lean LAB is used back in the sulphonator along with fresh feed of LAB.

❖ HITEC Electrostatic Precipitator

The HITEC electrostatic precipitator (ESP) employs a proprietary electrode design in an air jacketed bank of collection tubes. The High Intensity Toroidal Electron Corona (HITEC)



produced by the electrode charges the inlet particulars, which are collected at the passive tube wall. Coalesced organic acids (bottoms) discharge at the bottom of the vessel. Because the electrode assembly is rigidly supported from above, as opposed to conventional hang-wire designs.

All Charged parts of the electrostatic precipitator are constructed using 316 series stainless steel, and the design includes an internal spray washing system for cleaning the electrodes and vessel internals. Safety interlocks and manhole locks are provided to insure safe operation and maintenance of the unit. The transformer/rectifier is mounted on a structural support so that the high voltage bushing inserts directly into the vessel. This eliminates the need for high-tension insulated ducting (common in conventional designs) which can be a safety hazard and source of inefficiency. The Unit operates at much higher field strengths than conventional hang-wire units, and achieves much greater collection efficiencies, resulting in significantly reduced maintenance.

❖ SO₂ Scrubber

The packed tower SO₂ scrubber system is designed to operate with minimal operator attention as a semi-continuous batch recycle scrubber. The recycle tank is charged with a dilute caustic soda solution which is recirculated to the top of the absorber tower. The gas contacts the scrubbing solution counter currently as it passes upward through the tower to the final stack. The SO₂ gas present in the effluent stream is absorbed in the scrubbing solution and reacts with the caustic soda forming Na₂SO₃. As the caustic soda is consumed, the pH of the scrubbing solution falls, and a pH sensing/transmitter eventually activates an alarm to alert the operation that a new batch of scrubbing solution must be charged to the tank.

The batch time is planned so that under normal steady state running conditions, the recycle tank requires caustic and make-up water with an addition of no more than once per shift. When caustic soda is added, the tank is pumped down and recharged with fresh make-up water diluents so that the system never operates at solids concentrated above 8 wt% or with a pH less than 11. The sodium sulfite that is formed is oxidized to sodium sulphate (except during start-up), achieving 85% oxidation (or better) to Na₂SO₄ and further sodium sulphate liquid is subjected to steam heating to concentrate and resultant product is used in detergent industry.

2.8 Process Description

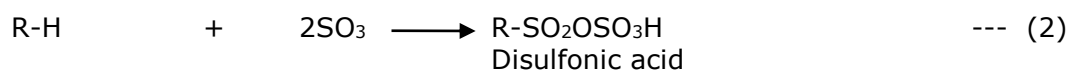
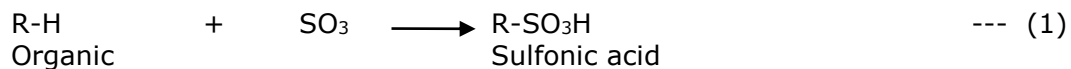
2.8.1 Sulfonation

The term "sulfonation" will indicate both the sulfonation and sulfation reactions, such a term meaning any reaction arising from the addition of SO₃ with an organic material regardless of the functional group characterizing the end product. The process flow chart is shown in **Figure-2.5**. The material balance of the sulphonation plant is shown in **Figure-2.6**.

The sulfonation reaction takes place simply by contact between the organic substance to be sulfonated and sulphur trioxide. The latter being a highly active reagent cannot be used in the concentrated form otherwise it would destroy the organic matter; consequently it is used at an approximate concentration of 4% by volume in dry air. Since reaction is highly exothermic, the product has to be cooled as the reaction proceeds, to avoid deterioration of the product which is heat-sensitive.



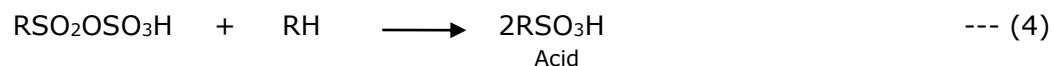
The main reactions occurring in the proposed plant are following:



Undesired reactions (2) and (3) take place only when the resulting by-products are almost entirely eliminated in the subsequent aging and hydrolysis steps.

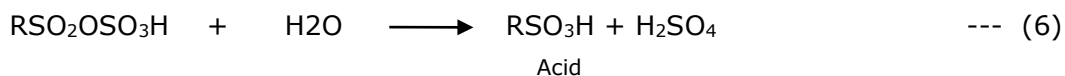
2.8.2 Aging

This operation eliminates partly the products of reaction (2) increasing at the same time the yield of useful products, as the excess SO_3 reacts with the unsulfonated organic matter.



2.8.3 Hydrolysis

This operation eliminates the excess SO_3 both dissolved and contained in the products of reactions (2) and (3) which would lead later to the acid degradation



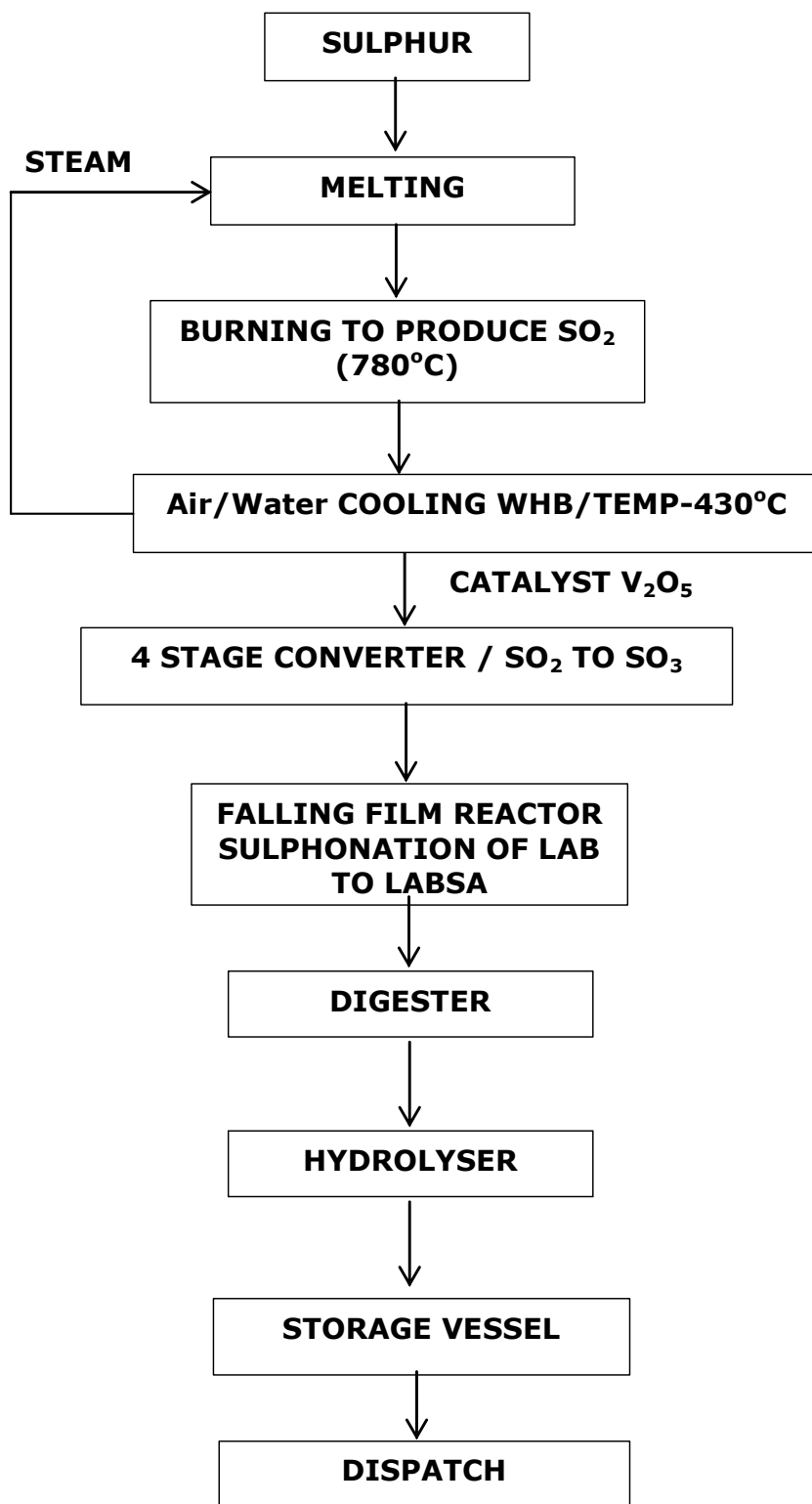


FIGURE – 2.5
PROCESS FLOW CHART

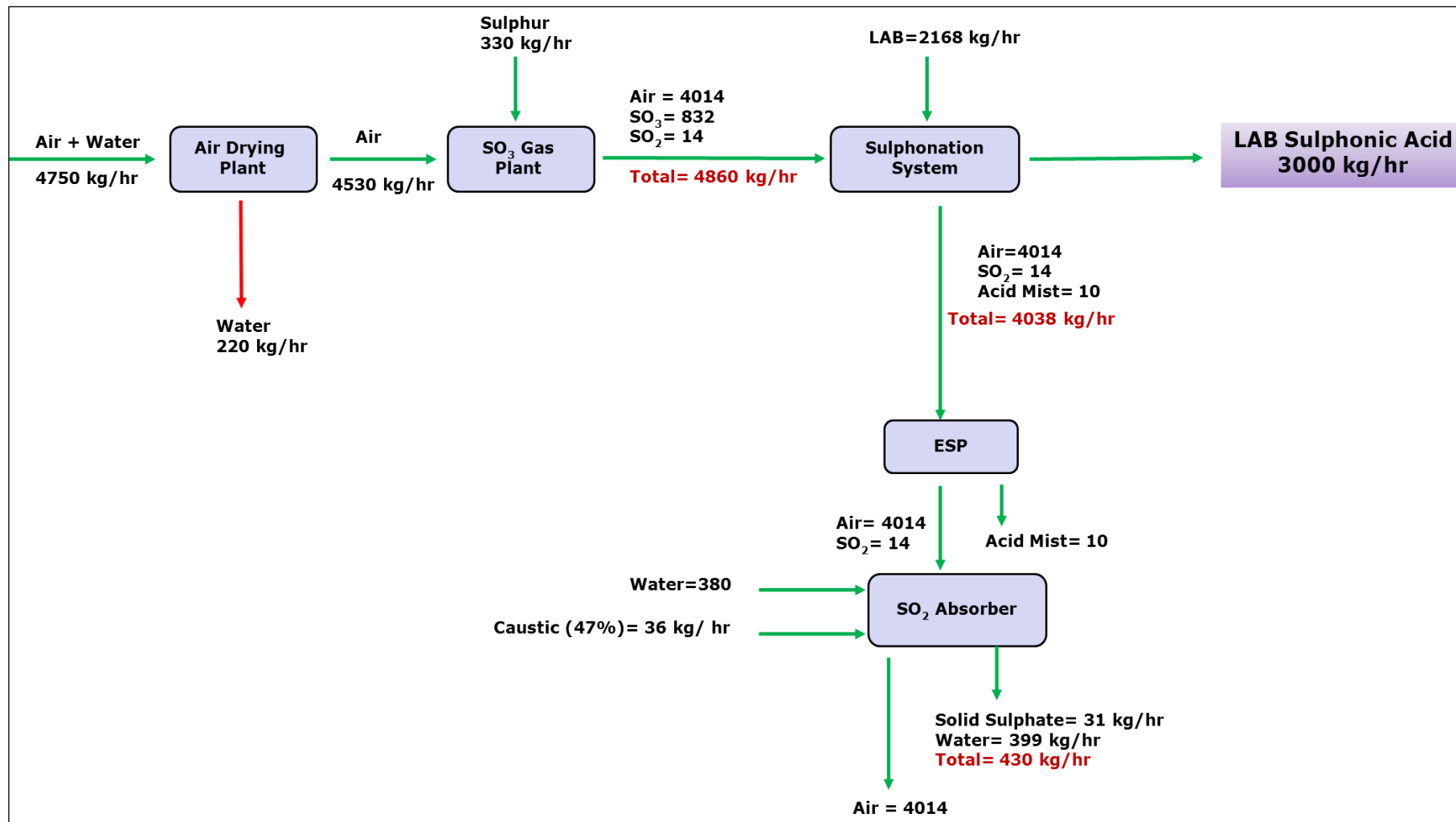


FIGURE – 2.6

MATERIAL BALANCE OF THE PROPOSED SULPHONATION PLANT



2.9 Sources of Pollution

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

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

2.9.1 Air Emissions

The main pollutants discharged from the sulphonation plant will be Sulphur dioxide emission whereas particulate matter and Nitrous oxide emission will be from the DG sets. HITEC Electrostatic Precipitator (ESP) and Alkali scrubber will be installed to reduce gaseous and dust emissions. The anticipated stack emission details are given in **Table-2.6**.

TABLE - 2.6
DETAILS OF STACK EMISSIONS FROM THE PROPOSED PLANT

Parameters	Units	Stack-1	Stack-2
Stack attached to	---	Sulphonation Plant	DG Set (1000 KVA)
Stack Height	m	38.0	15.0
Stack diameter	m	0.45	0.15
Temperature	°C	30	380
Exit Gas velocity	m/s	7.75	19.0
Flow rate	Nm ³ /hr	5431	1209
Sulphur dioxide	g/s	5.28	0.01

2.9.2 Wastewater/Effluent Generation and its Management

The main source of effluent generation in the proposed sulfonation plant is from cooling tower blow down, boiler blow down, alkali scrubber bleed-off, DM plant reject and domestic usages.

The daily fresh water requirement for the entire project will be about 30.4 KLD. The entire effluent generation of quantity 14.3 KLD will be treated in the proposed Effluent Treatment Plant capacity of 20 KLD and reused within the plant premises for various facilities. The domestic sewage (1.4 KLD) generated from the proposed project will be treated in the septic tank followed by dispersion trench. About 2.3 KLD of the treated water from the ETP will be reused for greenbelt maintenance. The details of sewage and effluent generation are given in **Table-2.7**



**TABLE - 2.7
DETAILS OF SEWAGE/EFFLUENT GENERATION**

Sr.No.	Description	Total Wastewater Generation (KLD)	Wastewater Management
1.	Domestic Wastewater	1.4	Septic Tank followed by Dispersion Trench
2.	Boiler Blow down	0.3	Treated in ETP
3.	Cooling Tower Blow down	14.0	Treated in ETP
Total		15.7	-

2.9.3 Solid Waste Generation and Management

Major solid wastes generated from the proposed sulphonation plant would include sulphur sludge (3.3 kg/day), spent catalyst (0.3 TPA), sulphur ash (0.7 TPA), scrubber residue (4.5 TPA) and ETP sludge (3.0 TPA). The details of solid waste generation are presented in **Table-2.8**.

**TABLE - 2.8
DETAILS OF SOLID WASTE GENERATION**

Sr. No.	Solid Waste	Category	Quantity	Method of Disposal
1	Sulphur sludge	28.1	0.003 TPD	Stored temporarily in HDPE bags and sent to secured landfill facility, Gummidipoondi
2	Spent Catalyst	28.2	0.3 TPA	Stored temporarily in polyethylene bags and send back to manufacturers for recycling the same
3	Sulphur ash	28.1	0.7 TPA	Stored temporarily in HDPE bags and sent to secured landfill facility, Gummidipoondi
4	Scrubber residue	28.1	4.5 TPA	Concentrated and used in detergent industry

Source: PSPL

Disposal of Solid Waste

The sulphur sludge generated will be deposited in sulphur melter process. The spent catalyst removed during annual shut-down will be stored in drums lined with polythene liners and will be sent back to supplier for rebinding the same. The sulphur ash and ETP sludge will be collected in HDPE Bags, stored in hazardous waste storage room and it will be disposed in the secured land fill facility located at Gummidipoondi.

2.9.4 Noise Pollution

The major noise generating sources from different facilities of the plant are listed in **Table-2.9**. Compressor is provided with acoustic enclosures to attenuate noise levels. The operators are provided with protective devices.



TABLE-2.9
NOISE LEVEL FROM THE PROPOSED PROJECT

Sr. No.	Sources	Noise Levels in dB(A)
1	Cooling Tower	70-80
2	Compressor	80-85
3	DG Sets	70-80
4	Loading & unloading operation	60-70
5	Vehicular movement (truck)	65-70

CHAPTER-3

BASELINE ENVIRONMENTAL STATUS



3.0 BASELINE ENVIRONMENTAL STATUS

3.1 Introduction

This chapter illustrates the description of the existing environmental status of the study area with reference to the prominent environmental attributes. The core area of the study covers 10 km radius around the proposed plant site. The existing environmental setting is considered to adjudge the baseline environmental conditions, which are described with respect to climate, hydro-geological aspects, atmospheric conditions, water quality, soil quality, vegetation pattern, ecology, socio-economic profile, land use and places of archaeological importance.

This report incorporates the baseline data monitored for the period from 1st April 2016 to 30th June 2016 and secondary data collected from various government, semi-government and public sector organizations.

3.2 Geology and Hydro-geology

3.2.1 Topography

The proposed plant site of Power Soaps Private Limited is located at Pondicherry Industrial Promotion Development & Investment Corporation Limited (PIPDIC) Industrial Estate, Sedarapet, Villianur Commune Panchayat, Pondicherry district, Puducherry. The plant area is generally flat terrain. This location extends at Latitude 12° 00' 08.61" N and Longitude 79° 45' 25" E. The average ground level of the area is 40 m AMSL. The topography is gently undulating land. The area is a notified industrial area.

3.2.2 Geology

The geological formations in the area range from Archaean to Recent. The Archaean formation is blackish grey granitoid gneisses and charnockite intruded at places by the pegmatites and dolerite dykes. The Cretaceous formation comprises calcareous sandstones, silicious limestones and fossiliferous limestones overlying the crystalline basements.

The most important Tertiary deposits consist of formations of upper Miocene age containing fluvial to brackish marine deposits of clays, sand, gravel, pebbles and lignite. These formations form potential aquifers, semi-confined and confined in nature. The soil type of the study area is classified as fine, mixed and belongs to sub group of Aeris Halaquepts. The drainage map of the study area is shown in **Figure-3.1**.

3.2.3 Geomorphology

The Puducherry region in general is a flat pen plain with an average elevation of 15-m above mean sea level. The terrain becomes a little undulating with prominent high grounds varying from 30 to 100-m above mean sea level towards northwest and northeastern parts of the region. Three major physiographic units are generally observed, viz., (i) Coastal plain, (ii) Alluvial plain and (iii) Uplands.

The coastal plain extends as a narrow stretch for about 22 km and of four to six hundred meters width on the eastern part of the region along the Bay of Bengal. The major part of the coastal plain comprises gently sloping land with a chain of sand dunes extending all



along the coast. Other physiographic units which are characteristic of the coastal plains such as spit bars, mud flats, lagoons and tidal inlets also occur.

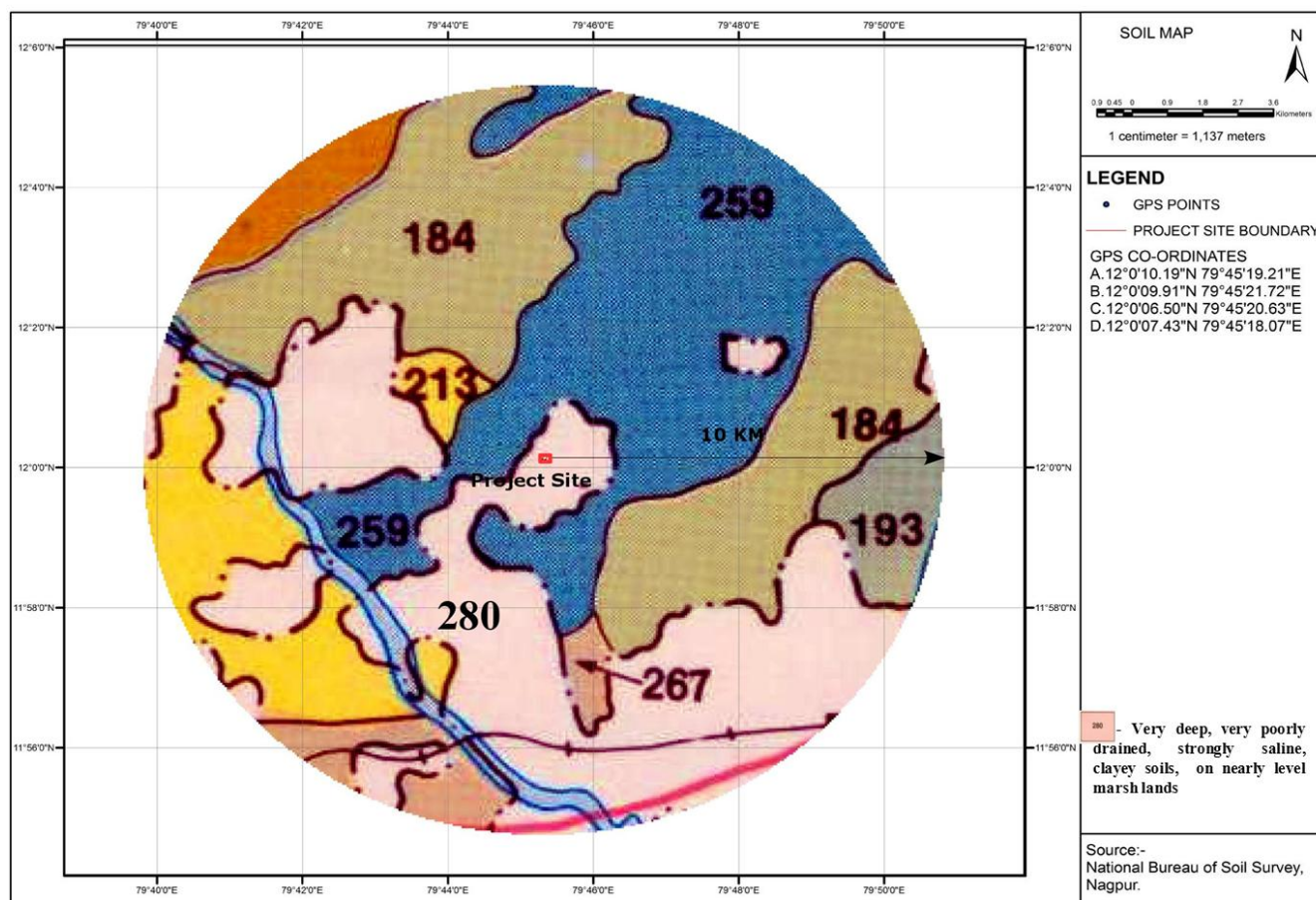


**FIGURE-3.1
GEOLOGY MAP OF THE STUDY AREA**

3.2.4 Hydrology and Water resources

Drainage

The alluvial plain, formed due to two major rivers namely Gingee and Ponnaiyar, in general is a monotonous plain with slope ranging from 1 to 3 percent. Besides the rivers and major canals, there are depressions acting as storage tanks, which are spread all over the terrain, to serve as surface water reservoirs. The Gingee river, which traverses the region diagonally from north-west to south-east and the Ponnaiyar (Penniyar) river, which forms the southern border of the region.

The river Gingee also known as the Varahanadi or Sankaraparani which has its source in the hills of Malayanur of Villupuram district, Tamil Nadu has a course of 34-km in this region before it confluences with the Bay of Bengal. The river Ponnaiyar originates from the hills of Karnataka and enters the Puducherry region after flowing through the districts of Dharmapuri, Salem, Vellore and Cuddalore of Tamil Nadu. All the rivers are ephemeral in nature. The drainage map of the study area is shown in **Figure-3.2**.

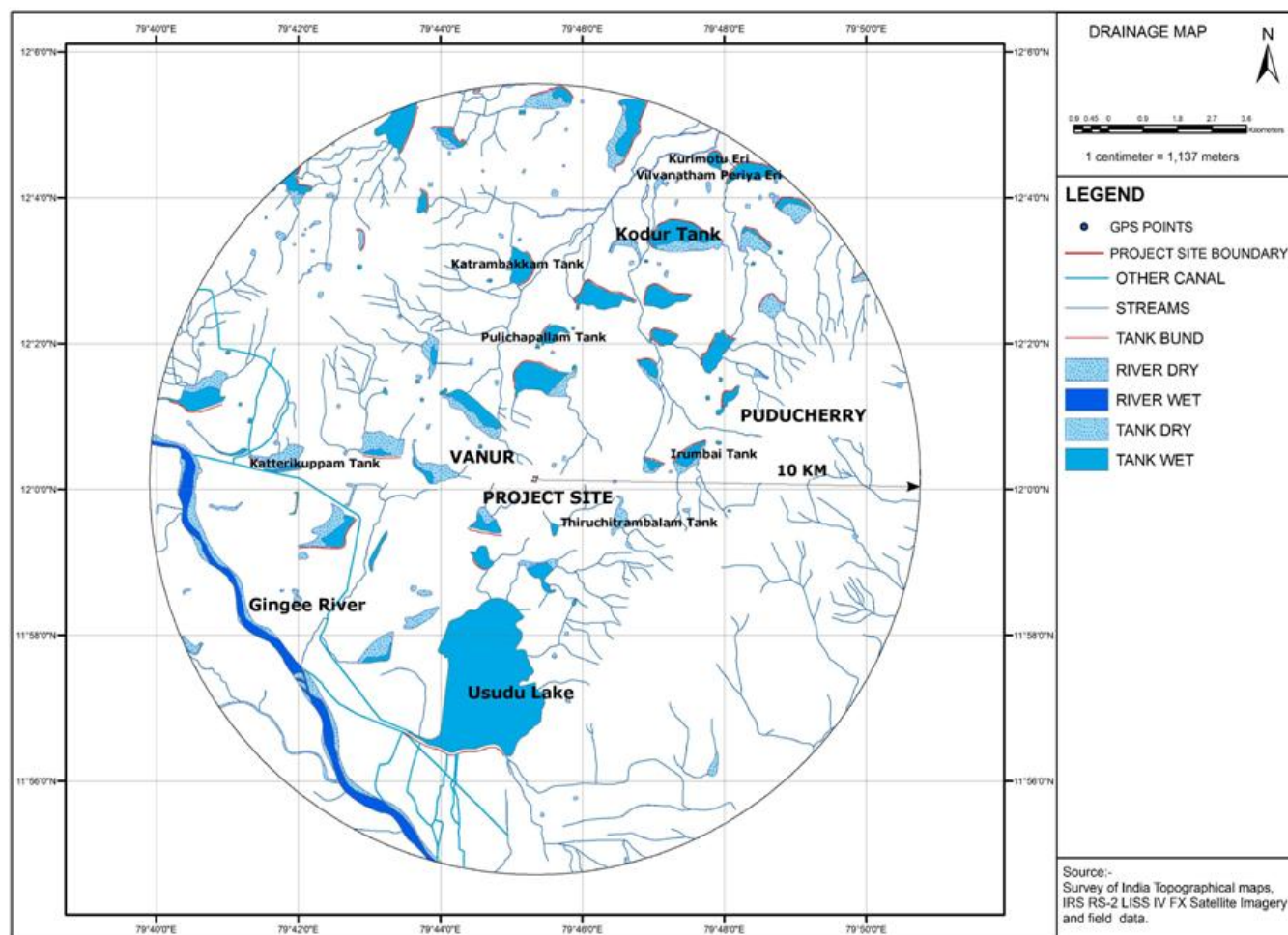


**FIGURE-3.2
DRAINAGE MAP OF THE STUDY AREA**

Ground Water

Ground water from all the aquifer systems is, in general, suitable both for domestic and irrigational needs except for isolated patches where high iron and chloride concentrations are reported. The water from Phreatic/Alluvial, Tertiary and Cretaceous aquifers from major parts of the region is of medium to high salinity and low sodium hazard as per U.S. Salinity lab classification. However water with high salinity and medium sodium hazard are reported from both Alluvial and Tertiary aquifers in the coastal areas of Puducherry region. Very high salinity and high sodium are reported from select wells along the coast due to sea water intrusion. The suitability of ground water for industries depends on the type of industry and the process involved. The waters have to be treated for softening for industrial uses at times.

The estimation of groundwater resources for the region has shown that the Puducherry Region is over exploited. Tube wells are the only ground water abstraction structures used for both domestic consumption and irrigation in the region. The yield of tube wells in shallow alluvial aquifers is of the order of 1 to 2 lakh litres/day. The extraction of ground water by shallow tube wells in the alluvium is of the order of 2.5 ha.m./year. The average



command area for tube well is about 3 ha. The deep tube wells of 200 mm dia and 100 – 400 m depth in Tertiary and Cretaceous aquifers can yield as high as 1000 lpm (litres per minute) discharge, which can be pumped with 10 to 15 HP submersible pumps. The average annual draft of deep tube wells varies from 70 – 200 m³/hr.

3.2.5 Hydrogeology

Sands and gravels constitute the alluvial aquifers. Alluvial deposits occupy nearly three fourth of the region. These aquifers form the most potential shallow aquifer system in the area. The thickness of these aquifers ranges between 5 and 34 m. Villiyanur is one of the area bordered by Thick alluvial aquifers. In these regions the ground water occurs under water table or semi-confined conditions. The depth of tube wells tapping these aquifers range between 25 and 50 m bgl (below ground level). The hydrogeology map of Pondicherry is shown in **Figure-3.3** and legend for the hydrogeology map of Pondicherry is shown in **Figure-3.4**.

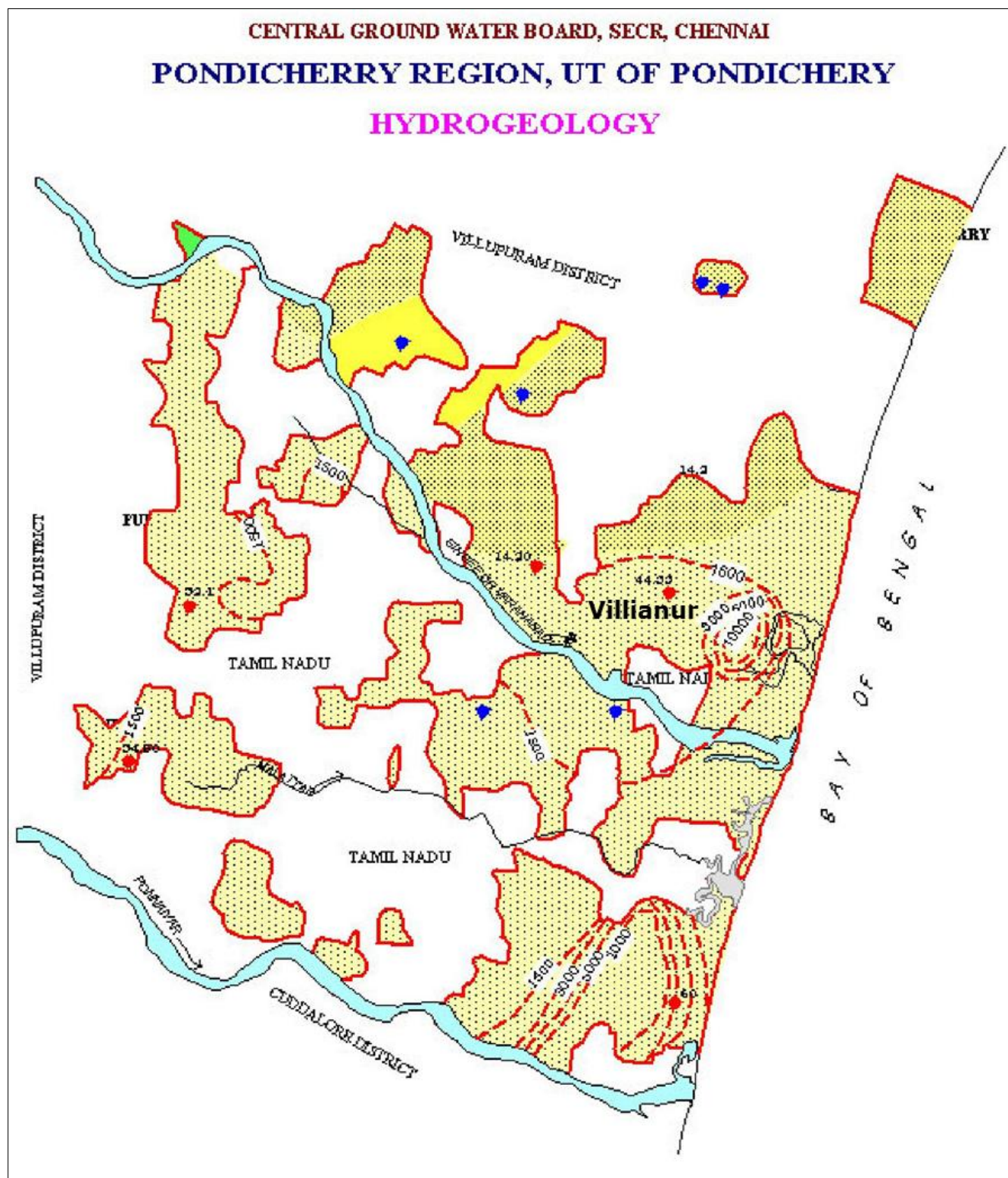


FIGURE-3.3
HYDROGEOLOGY MAP OF PONDICHERY



LEGEND FOR PLATE VIII

ADMINISTRATIVE SETUP

- — — STATE BOUNDARY
- △⁷⁵² TRIANGULATION HEIGHT
[elevation in mamsl]
- CREEK

GROUND WATER HYDROLOGY

- ◆ EXPLORATORY BORE WELL [CGWB]
- 14.2 ◆ LOCATION OF HIGH YIELD IN EXPLORATORY WELL WITH DISCHARGE IN LPS [CGWB]

HYDROCHEMISTRY

- 750 ○ ISOCONS [Sp ELECTRICAL CONDUCTANCE [μs /Cm at 25° C]

STRUCTURE

- — — TRACE OF LINEAMENT

<u>AQUIFER</u>	<u>AGE</u>	<u>LITHOLOGY</u>	<u>GROUND WATER CONDITIONS</u>	<u>YIELD PROSPECTS (CUM/D)</u>	<u>GROUND WATER DEVELOPMENT STRATEGIES</u>	
	UNCONSOLIDATED	RECENT	SAND & GRAVEL	UNCONFINED	< 200	DEVELOPMENT THROUGH TUBE WELLS OF 25 - 50 MDEPTH
	UNCONSOLIDATED	TERTIARY	SANDSTONE	DISCONTINUOUS PATCHES OCCUR AS UNCONFINED AQUIFER. MAINLY OCCUR AS CONFINED AQUIFER.	1000 - 2000	DEVELOPMENT THROUGH TUBE WELLS OF 25 - 350 MDEPTH
	UNCONSOLIDATED	CRETACEOUS	CALCAREOUS SANDSTONE & LIMESTONE	DISCONTINUOUS PATCHES OCCUR AS UNCONFINED AQUIFER. MAINLY OCCUR AS CONFINED AQUIFER.	700 - 1000	DEVELOPMENT THROUGH TUBE WELLS OF 65 - 400 MDEPTH
	CONSOLIDATED	ARCHAean	CHARNOCKITE	OCCUR AS UNCONFINED AQUIFER IN WEATHERED MANTLE & SEMI CONFINED TO CONFINED AQUIFER IN FRACTURES	100 - 200	DEVELOPMENT THROUGH DUG WELLS OF 10 - 15 MDEPTH

FIGURE-3.4
LEGEND FOR HYDROGEOLOGY MAP OF PONDICHERRY



3.3 Meteorology

The meteorological data recorded during the study period is very useful for proper interpretation of the baseline information as well as for input to prediction models for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying general meteorological regime of the region.

On-site monitoring was undertaken for various meteorological variables in order to record the site-specific data. Data was recorded every hour continuously from 1st April 2016 to 30th June 2016. Indian Meteorological Department has been monitoring surface observations at Cuddalore. Temperature, relative humidity, rainfall, wind speed and direction are measured twice a day viz., at 0830 and 1730 hr. The data of wind speed, direction and other parameters of IMD, Cuddalore has been obtained for the past available 10 years and processed. Data on Cloud cover is compiled from the climatological tables for the IMD station at Cuddalore.

The year may broadly be divided into four seasons:

- Winter season : December to February
- Pre-monsoon season : March to May
- Monsoon season : June to September
- Post-monsoon season : October to November

3.3.1 Meteorological Data Recorded at Site

The meteorological parameters were recorded at site on hourly basis during the study period and consists of parameters like wind speed, wind direction and temperature. The total rainfall was recorded daily once at 0830 hrs. The maximum and minimum values for all the parameters except wind speed and wind direction are presented in **Table-3.1**.

**TABLE - 3.1
SUMMARY OF THE METEOROLOGICAL DATA GENERATED AT SITE**

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	Max	Min	Max	Min	
April 2016	39.0	24.0	73	58	14.1
May 2016	38.0	26.0	81	64	3.4
June 2016	41.0	28.0	83	66	12.7

1) Temperature

The maximum temperature was observed to be 41°C during June 2016 and minimum temperature was observed to be 24°C during April 2016.

2) Relative Humidity

The Relative Humidity was observed to be a maximum of 83 % for the month of June 2016 and a minimum of 58 % for the month of April 2016.

3) Rainfall

A total rainfall of 30.2 mm was observed during the study period.



4) Wind Speed and Direction

The predominant winds along with wind speeds during the study period are represented as windrose in **Figure-3.5** and summary of the wind pattern is given in **Table - 3.2**.

A review of the wind rose diagram shows that predominant winds are mostly from South, SE and followed by ESE direction. The predominant winds from South direction were observed for 16.3% of the total time, whereas in SE direction was observed for 15.5% of the total time. In ESE direction the winds were observed for 10.5% of the total time.

TABLE - 3.2
SUMMARY OF WIND PATTERN IN STUDY AREA

Season	First Predominant Wind Direction	Second Predominant Wind Direction	Predominant Wind Speed (kmph)	Calm (%)
Pre monsoon 2016	South (16.3)	SE (15.5)	11.1 – 19.0	7.6

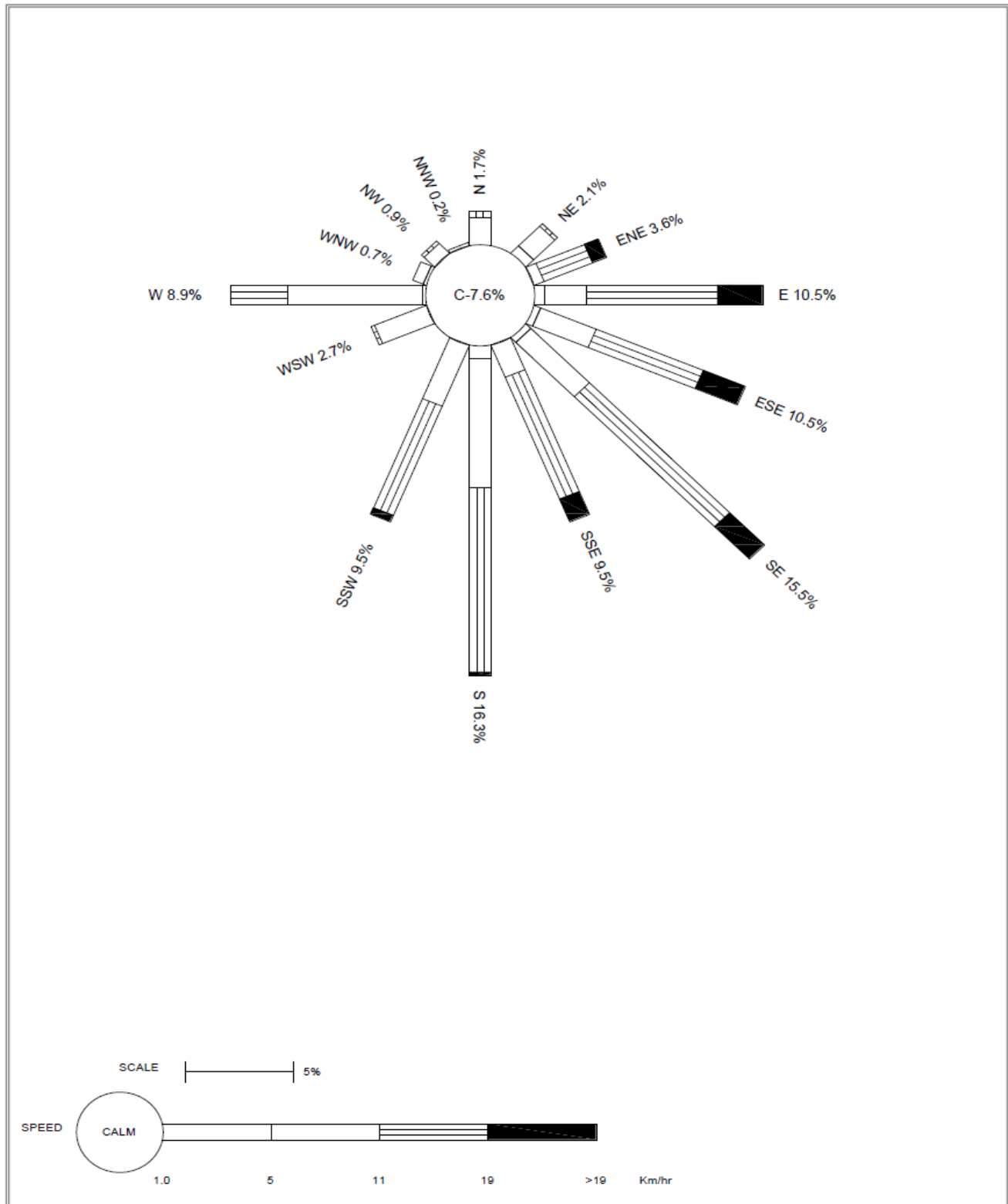


**FIGURE - 3.5
SITE SPECIFIC WINDROSE – PRE-MONSOON 2016**



3.3.2 Secondary Data from IMD-Cuddalore

Secondary meteorological data from IMD-Cuddalore has been collected for temperature, relative humidity, atmospheric pressure, rainfall, wind speed and wind direction. The data at IMD is usually recorded twice a day viz. at 0830 hr and 1730 hr.

3.3.2.1 Meteorological Data

The nearby India Meteorological Department station that is generating meteorological data is in the project site itself i.e. IMD, Cuddalore. Hence, secondary information on meteorological conditions has been collected from IMD station at Cuddalore.

India Meteorological Department – Cuddalore

India Meteorological Department has been monitoring surface observations at Cuddalore. Temperature, relative humidity, rainfall, wind speed and direction are measured twice a day viz., at 0830 and 1730 hr. The data of IMD, Cuddalore station has been obtained for the past available 10 years (1999-2008). Data on Cloud cover is compiled from the climatological tables for the IMD station at Cuddalore.

The monthly data for all the parameters except wind speed and wind direction is presented in **Table-3.3**.

TABLE - 3.3
CLIMATOLOGICAL DATA STATION: IMD, CUDDALORE

Month	Atmospheric Pressure (mb)		Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	0830	1730	Max.	Min.	0830	1730	Monthly Total
January	1013.9	1010.8	27.7	20.6	84	72	40.5
February	1012.8	1009.5	28.8	21.0	85	71	14.9
March	1011.3	1007.4	31.1	23.2	81	71	26.5
April	1009.2	1005.1	33.1	25.8	76	74	36.9
May	1005.6	1001.4	35.9	27.3	69	71	70.1
June	1004.9	1000.9	37.1	27.1	64	63	33.8
July	1005.1	1001.7	35.5	26.2	69	60	68.1
August	1005.7	1001.9	34.8	25.6	74	67	110.2
September	1006.9	1003.3	34.1	25.2	74	70	112.3
October	1009.3	1005.5	31.6	24.2	82	76	240.6
November	1011.1	1007.9	29.2	22.5	84	77	363.4
December	1012.7	1009.8	28.0	21.3	84	74	181.1

Source: Climatological Tables of IMD (1999-2008)

3.3.2.2 Wind Speed and Direction

The details of the wind speeds and directions as monitored by IMD are given in **Table-3.4**. The wind roses are presented in **Figure-3.6** to **Figure-3.10**.



**TABLE - 3.4
SUMMARY OF WIND PATTERN – IMD, CUDDALORE**

Season	First Predominant Winds (%)		Second Predominant Winds (%)		% Calm Condition	Predominant Wind Speed (KMPH)
	0830	1730	0830	1730		
Winter	NNW (20.1)	NNE (29.3)	N (19.6)	NE (28.1)	7.9	1-19
Summer	SW (14.7)	SE (53.5)	SSW (14.5)	ESE (18.1)	14.9	1-19
Monsoon	WSW (27.1)	SE (38.3)	SW (26.2)	SSE (13.5)	10.4	1-19
Post-Monsoon	NNE (15.9)	NNE (26.6)	N (14.9)	NE (17.4)	13.8	1-19
Annual	SW (11.8)	SE (29.7)	SW (11.8)	NNE (13.9)	11.7	1-19

Source: Climatological Tables of IMD, Cuddalore

3.3.2.3 Comments

The India Meteorological Department records the data two times a day viz. 0830 hr and 1730 hr, while the site-specific data has been recorded at an hourly interval. On comparison of site-specific data generated for study period vis-à-vis the IMD data, slight variations were found. The following observations are brought out:

- Slight variations were found in the temperature recorded On-site, when compared with IMD. The maximum and minimum temperatures recorded at site during study period were 41.0 °C and 24.0 °C, whereas the maximum and minimum values recorded at IMD, Cuddalore are 37.1° C and 20.6° C respectively during the same period;
- The Relative Humidity was observed to range from 58% – 83% during the study period whereas according to IMD, Cuddalore the Relative Humidity was observed to be ranging from 60% to 85%. No appreciable variations are found in the RH values in comparison with IMD data;
- From the data generated through continuous monitoring station at project site and the data recorded at IMD, it can be observed that the data generated at the site is broadly compatible with regional meteorology, except minor variations as described above. However, the data cannot be compared on one to one basis as the two stations (IMD and site) are away and there is elevation difference also.

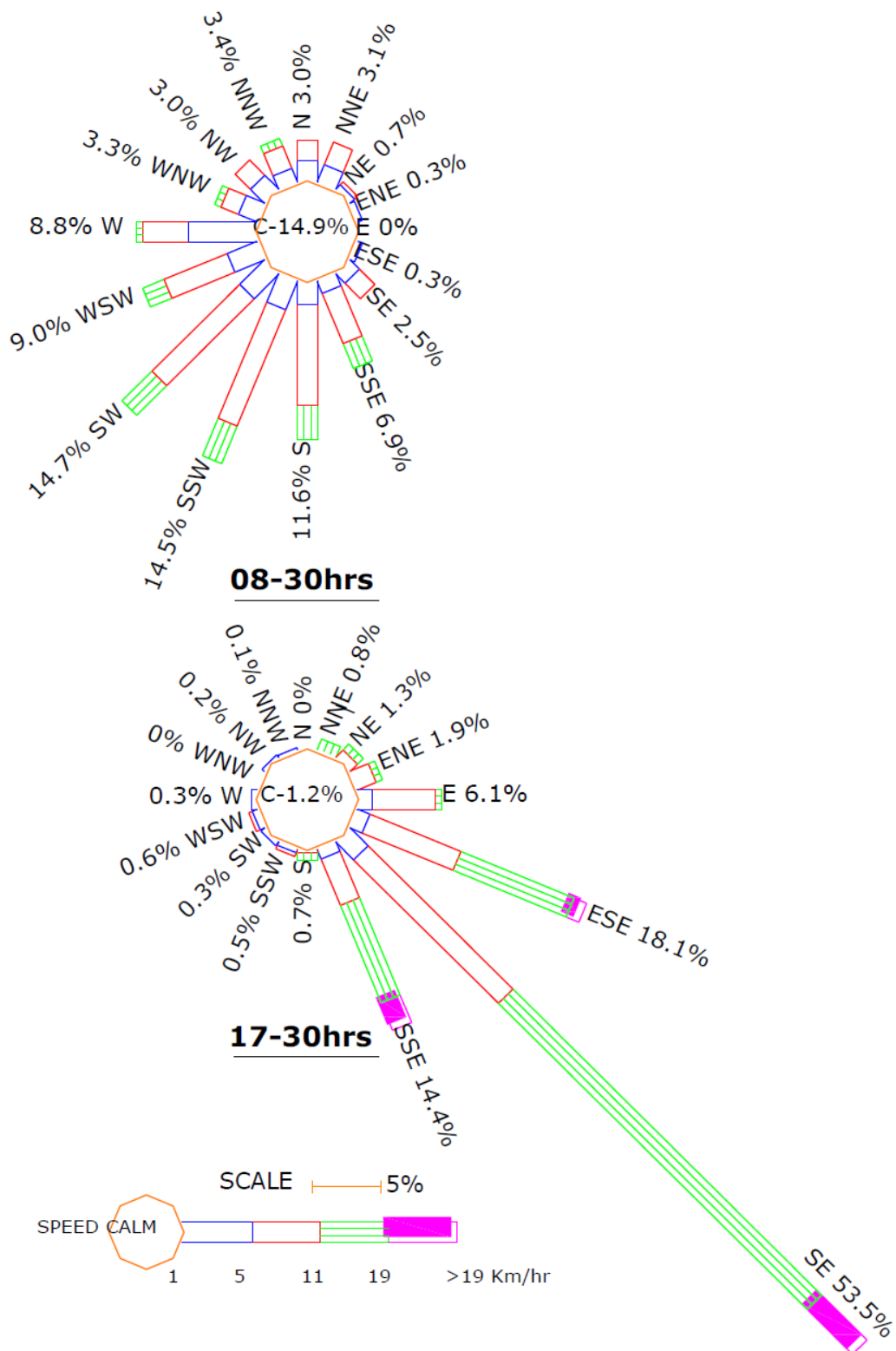


FIGURE-3.6
WIND ROSE – PRE-MONSOON SEASON (IMD-CUDDALORE)

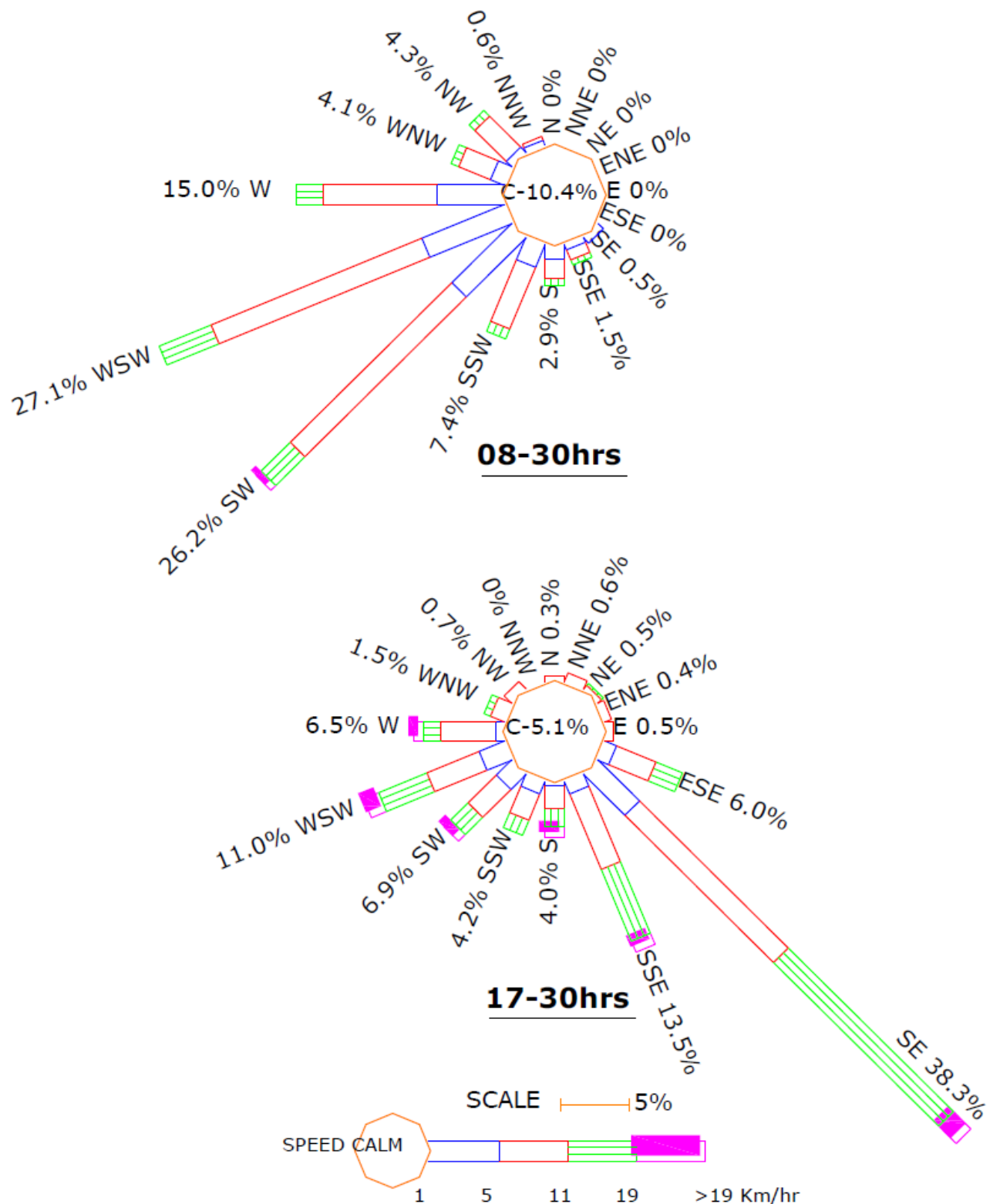


**FIGURE-3.7
WIND ROSE - MONSOON SEASON (IMD- CUDDALORE)**

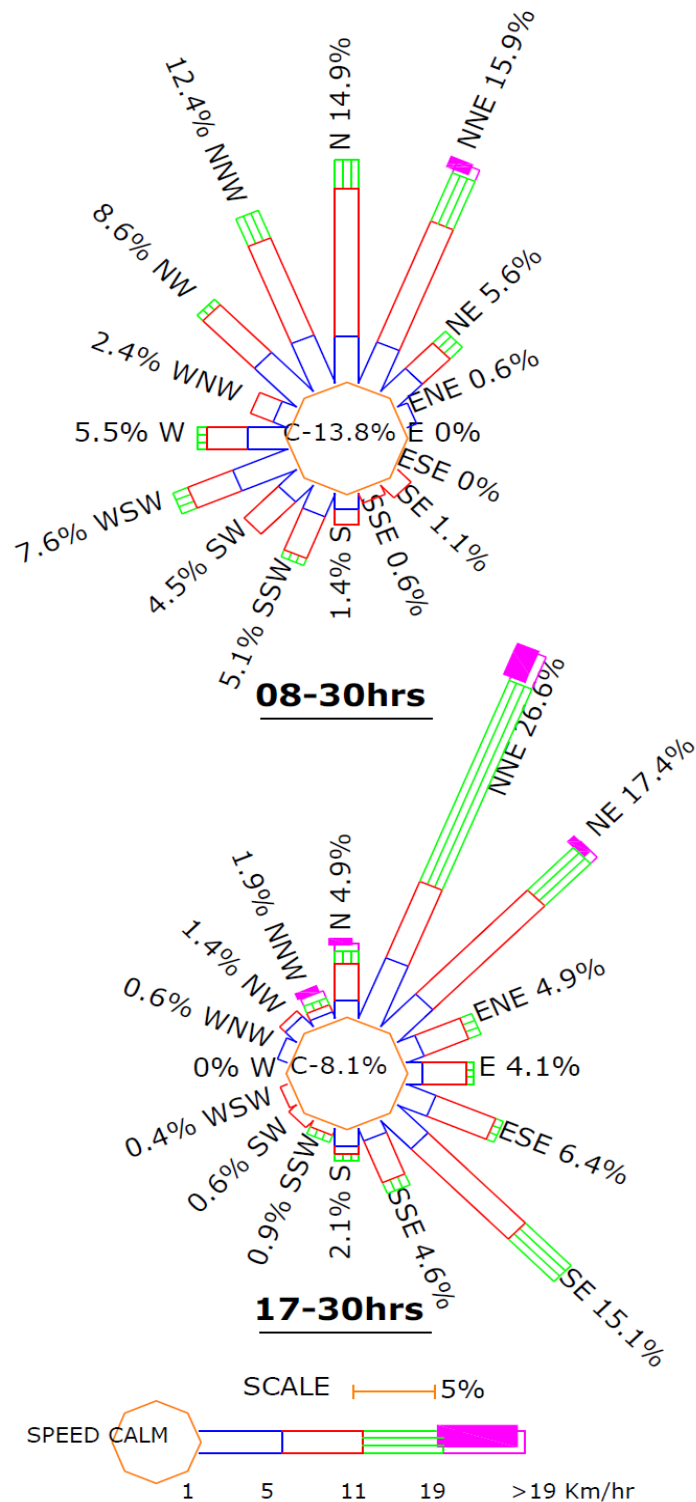


**FIGURE-3.8
WIND ROSE - POST MONSOON SEASON (IMD- CUDDALORE)**

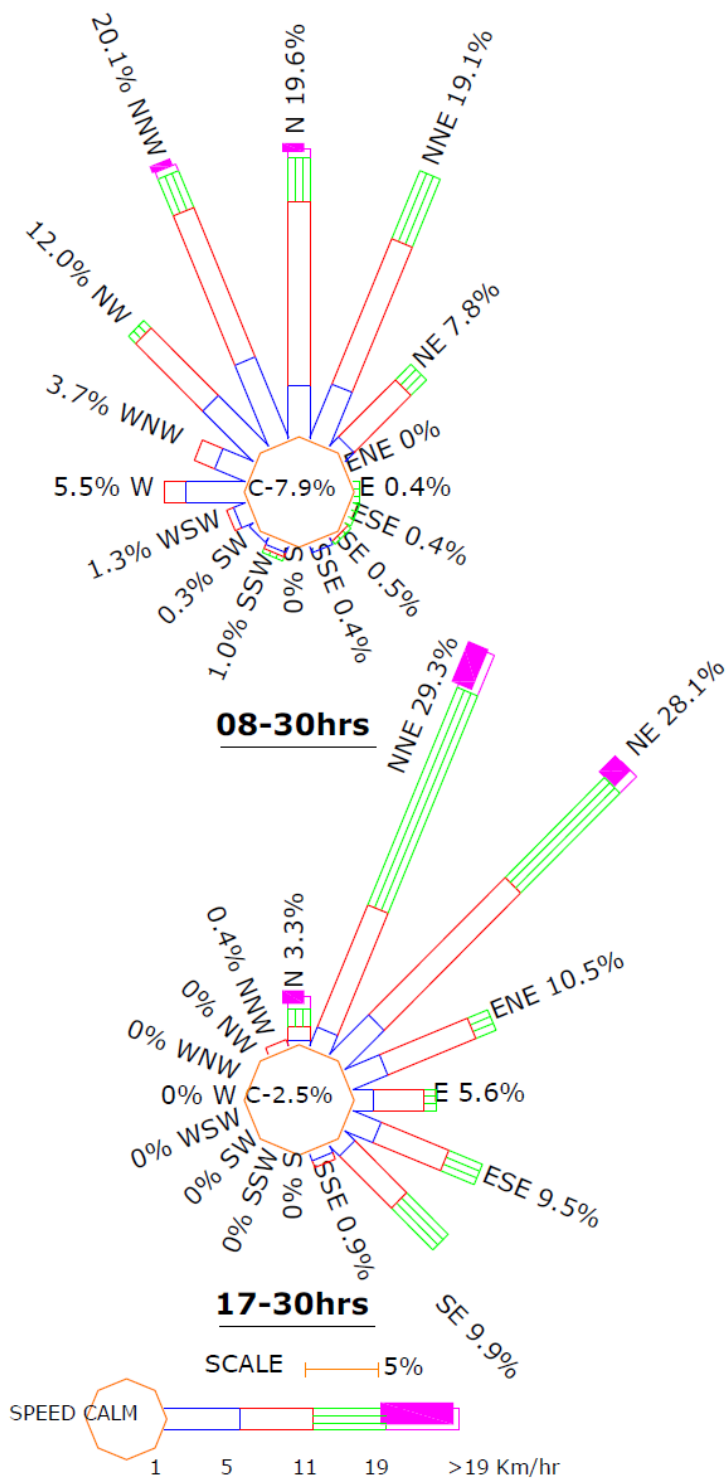


**FIGURE-3.9
WIND ROSE - WINTER SEASON (IMD- CUDDALORE)**

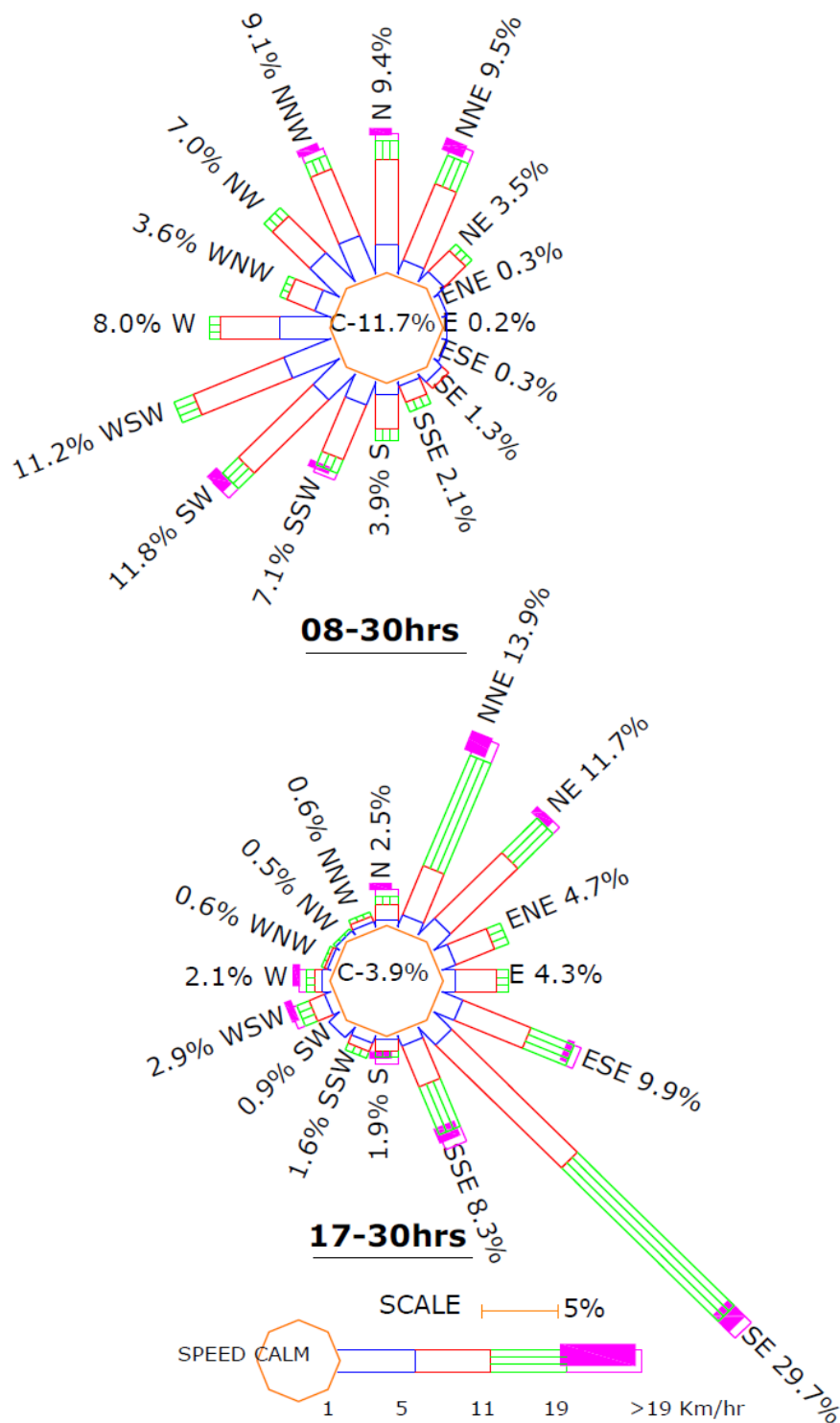


**FIGURE-3.10
WIND ROSE - ANNUAL PATTERN (IMD- CUDDALORE)**



3.4 Air Quality

The ambient air quality with respect to the study zone of 10 km radius around the project site forms the baseline information. The various sources of air pollution in the region are industrial, traffic and rural activities. This will also be useful for assessing the conformity to ambient air quality standards during the plant operation.

This section describes the selection of sampling locations, methodology adopted for sampling, analytical techniques and frequency of sampling. The monitoring was carried out for the study period from 1st April 2016 to 30th June 2016.

3.4.1 Methodology Adopted for Air Quality Survey

3.4.1.1 Selection of Sampling Locations

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance program has been based on the following considerations:

- Meteorological conditions on synoptic basis;
- Topography of the study area;
- Representatives of regional background air quality for obtaining baseline status;
- Representatives of likely impact areas.

Ambient Air Quality Monitoring (AAQM) stations were set up at eight (8) locations with due consideration to the above mentioned points. **Table-3.5** gives the details of environmental setting around each monitoring station.

The location of the selected stations with reference to the plant boundary is given in the same table and shown in **Figure-3.11**.

**TABLE - 3.5
DETAILS OF AMBIENT AIR QUALITY MONITORING LOCATIONS**

Code	Name of the Location	Distance from plant boundary (km)	Direction w.r.t. plant boundary
AAQ1	Project Site	---	---
AAQ2	Puliapallam	3.1	North
AAQ3	Vanur	2.9	NW
AAQ4	Pudupakkam	2.9	WNW
AAQ5	Karasur	2.6	SW
AAQ6	Turuvai	2.8	NE
AAQ7	Tiruchitrambalam	2.6	SE
AAQ8	Kutturoad	2.8	ESE

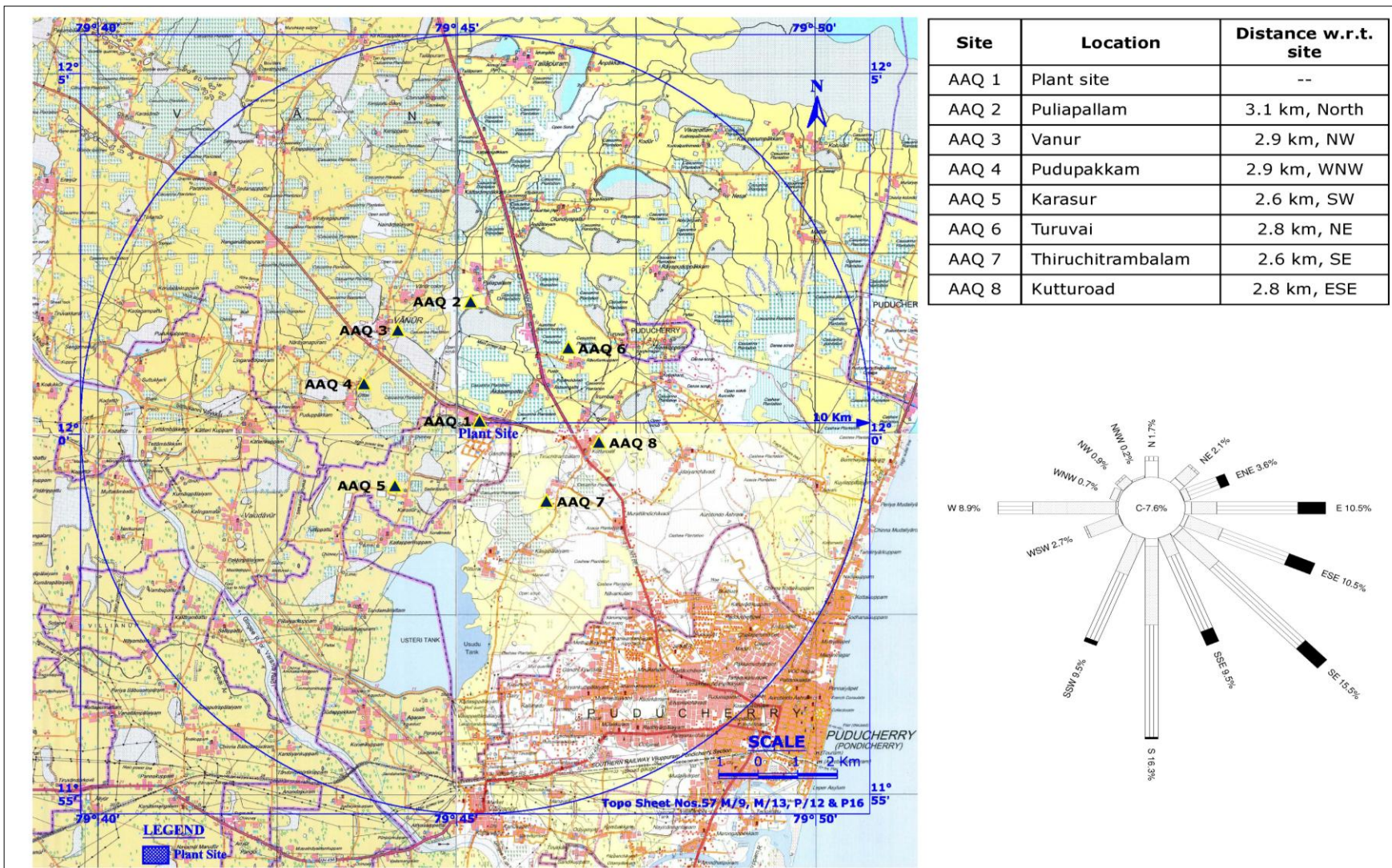


**FIGURE-3.11
AIR QUALITY SAMPLING LOCATIONS**



3.4.1.2 Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of two days per week at all locations during the study period from 1st April 2016 to 30th June 2016. The baseline data of air environment is generated for the following parameters:

- Particulate Matter (PM₁₀);
- Particulate Matter (PM_{2.5});
- Sulphur dioxide (SO₂);
- Nitrogen dioxide (NO₂);
- Carbon monoxide (CO);
- Ozone (O₃);
- Ammonia (NH₃);
- Lead (Pb);
- Arsenic (As);
- Nickel (Ni);
- Benzene (C₆H₆);
- Benzo (a) Pyrene
- HC & VOCs

3.4.2 Duration of Sampling

The sampling duration for PM₁₀, PM_{2.5}, SO₂, NO₂, Pb, NH₃, C₆H₆, BaP, As and Ni was twenty-four hourly continuous samples per day and CO & O₃ was sampled for 8-hrs continuously thrice a day. This is to allow a comparison with the present revised standards mentioned in the latest Gazette notification of the Central Pollution Control Board (CPCB) (November 16, 2009).

**TABLE - 3.6
MONITORED PARAMETERS AND FREQUENCY OF SAMPLING**

Parameters	Sampling Frequency
PM ₁₀	24 hourly sample twice a week for three months
PM _{2.5}	24 hourly sample twice a week for three months
Sulphur dioxide (SO ₂)	24 hourly sample twice a week for three months
Oxides of Nitrogen (NO _x)	24 hourly sample twice a week for three months
Ozone (O ₃)	08 hourly sample twice a week for three months
Ammonia (NH ₃)	24 hourly sample twice a week for three months
Lead (Pb)	24 hourly sample twice a week for three months
Arsenic (As)	24 hourly sample twice a week for three months
Nickel (Ni)	24 hourly sample twice a week for three months
Carbon Monoxide (CO)	08 hourly sample twice a week for three months
Benzene (C ₆ H ₆)	24 hourly sample twice a week for three months
Benzo (a) Pyrene	24 hourly sample twice a week for three months
Hydrocarbons (HC)	8 hourly samples for twice a week for three months
VOCs	8 hourly samples for twice a week for three months



3.4.3 Method of Analysis

The air samples were analyzed as per standard methods specified by Central Pollution Control Board (CPCB), IS: 5184 and American Public Health Association (APHA).

3.4.3.1 Instruments used for Sampling

Dust Samplers of Pollutech instruments were used for monitoring PM₁₀ (<10 microns), PM_{2.5} and gaseous pollutants like SO₂ and NO₂. Glass tubes were deployed for collection of grab samples of Carbon monoxide. Gas Chromatography techniques have been used for the estimation of CO, C₆H₆ & BaP. ICP (Inductively Coupled Plasma) has been used for Pb, As & Ni and O₃ & NH₃ analysed using Chemiluminescence method.

3.4.4 Sampling and Analytical Techniques

The techniques used for ambient air quality monitoring and minimum detectable levels are given in **Table-3.7**.

TABLE - 3.7
TECHNIQUES USED FOR AMBIENT AIR QUALITY MONITORING

Sr.No.	Parameters	Test method	Low detection limit
1.	PM ₁₀ (Respirable Particulate Matter % Suspended Particulate Matter)	Gravimetric (Respirable dust sampling / High volume sampling)	5.0µg/m ³
2.	PM _{2.5}	Gravimetric (FRM method / Low volume sampling)	2.0µg/m ³
3.	Sulphur dioxide (SO ₂)	Modified West & Gaeke method	4.0µg/m ³
4.	Nitrogen dioxide (NO ₂)	Sodium Arsenite method	9.0µg/m ³
5.	Ozone (O ₃)	Spectrophotometric method	2.0µg/m ³
6.	Ammonia (NH ₃)	Indo-phenol blue method	20.0µg/m ³
7.	Lead (Pb)	AAS/ICP-MS method after sampling on EPM filter paper	0.05 ng/m ³
8.	Arsenic (As)	AAS/ICP-MS method after sampling on EPM filter paper	0.2 ng/m ³
9.	Nickel (Ni)	AAS/ICP-MS method after sampling on EPM filter paper	0.10 ng/m ³
10.	Carbon Monoxide (CO)	Adsorption and extraction followed by GC-MS analysis	12.5µg/m ³
11.	Benzene (C ₆ H ₆)	Adsorption and desorption followed by GC-MS analysis	1.0 ng/m ³
12.	Benzo (a) Pyrene (BaP)	Solvent extraction followed by GC-MS	1.0 ng/m ³
13.	Hydrocarbons	Gas Chromatography Method	0.01 ppm
14.	VOCs	Gas Chromatography Method	--

3.4.5 Presentation of Primary Data

The survey results for the study period from 1st April 2016 to 30th June 2016 are presented in detail in **Annexure-V**. The summary of these results for each location is presented in **Table-3.8 (a) and (b)**. These are compared with the standards prescribed by Central Pollution Control Board (CPCB).



**TABLE - 3.8 (a)
SUMMARY OF AMBIENT AIR QUALITY RESULTS**

Parameters		AAQ-1	AAQ-2	AAQ-3	AAQ-4
PM₁₀	Maximum	76.4	64.7	62.8	61.5
	Minimum	65.3	48.3	46.8	45.9
	Average	70.9	61.3	59.4	58.2
	98%tile	76.0	64.7	62.8	61.5
PM_{2.5}	Maximum	26.0	16.1	15.6	15.3
	Minimum	23.2	11.6	11.2	11.0
	Average	25.0	14.3	13.8	13.6
	98%tile	25.9	16.0	15.6	15.2
SO₂	Maximum	14.1	13.3	12.9	13.2
	Minimum	11.1	10.5	11.2	10.9
	Average	12.4	12.6	12.3	12.6
	98%tile	13.3	13.3	12.9	13.2
NO₂	Maximum	20.0	19.7	18.9	19.6
	Minimum	14.1	14.5	16.9	16.6
	Average	16.0	18.9	18.1	18.5
	98%tile	18.0	19.7	18.9	19.6
CO	Maximum	570	568	553	542
	Minimum	387	459	445	436
	Average	479	517	502	492
	98%tile	567	564	550	539

**TABLE - 3.8 (b)
SUMMARY OF AMBIENT AIR QUALITY RESULTS**

Parameters		AAQ-5	AAQ-6	AAQ-7	AAQ-8
PM₁₀	Maximum	48.6	56.6	52.9	46.3
	Minimum	36.4	44.9	41.2	39.6
	Average	45.9	51.1	49.6	43.9
	98%tile	48.6	56.2	52.7	46.2
PM_{2.5}	Maximum	12.6	13.6	15.6	13.7
	Minimum	9.6	9.8	10.4	9.7
	Average	11.4	11.8	12.0	11.0
	98%tile	12.6	13.4	14.4	13.6
SO₂	Maximum	13.4	13.3	12.7	13.2
	Minimum	6.2	11.0	10.7	10.4
	Average	12.5	12.6	11.9	12.0
	98%tile	13.9	13.3	12.7	13.2
NO₂	Maximum	17.4	19.1	16.4	18.2
	Minimum	13.1	16.5	13.2	13.8
	Average	14.8	18.2	15.0	16.0
	98%tile	17.2	19.1	16.4	18.0
CO	Maximum	454	551	528	466
	Minimum	384	441	448	387
	Average	425	480	496	432
	98%tile	454	545	528	463

Note: 1. All values given in the table are expressed in $\mu\text{g}/\text{m}^3$

2. Ozone (O_3), Ammonia (NH_3), Lead (Pb), Arsenic (As) ng/m^3 , Nickel (Ni) ng/m^3 , Mercury (Hg), Benzene (C_6H_6) and Benzo(a)Pyrene(BaP) ng/m^3 are below the Detectable Limits.



3.4.5.1 Observations of Primary Data

PM₁₀: The maximum and minimum concentrations for PM₁₀ were recorded as 76.4- $\mu\text{g}/\text{m}^3$ and 36.4- $\mu\text{g}/\text{m}^3$ respectively. The maximum concentration was recorded at project site (AAQ1) and the minimum concentration was recorded at Karasur (AAQ5) during the study period.

PM_{2.5}: The maximum and minimum concentrations for PM_{2.5} were recorded as 26- $\mu\text{g}/\text{m}^3$ and 9.6- $\mu\text{g}/\text{m}^3$ respectively. The maximum concentration was recorded project site (AAQ1) and the minimum concentration was recorded at Karasur (AAQ5) during the study period.

SO₂: The maximum and minimum SO₂ concentrations were recorded as 14.1- $\mu\text{g}/\text{m}^3$ and 6.2- $\mu\text{g}/\text{m}^3$. The maximum concentration was recorded at project site (AAQ1) and the minimum concentration was recorded at Karasur (AAQ5) during the study period.

NO₂: The maximum concentration of 20.0- $\mu\text{g}/\text{m}^3$ for NO₂ was recorded at project site (AAQ1) with minimum of 13.1- $\mu\text{g}/\text{m}^3$ observed at Karasur (AAQ5) during the study period.

CO: The maximum and minimum CO concentrations were recorded as 570- $\mu\text{g}/\text{m}^3$ and 384- $\mu\text{g}/\text{m}^3$. The maximum concentration was recorded at project site (AAQ1) and the minimum concentration was recorded at Karasur (AAQ5) during the study period.

HC & VOCs: The levels of hydrocarbons (HC) and Volatile Organic Compounds (VOCs) were found to be below detectable limits.

The concentrations of PM₁₀, PM_{2.5}, SO₂, NO₂ and CO are observed to be well within the standards prescribed by Central Pollution Control Board (CPCB) for Industrial, Rural, Residential and Other area.

3.5 Water Quality

Selected water quality parameters of ground water and surface water resources within 10 km radius of the study area has been studied for assessing the water environment and evaluate anticipated impacts of the proposed project. The purpose of this study is to:

Assess the water quality characteristics for critical parameters;

- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict impact on water quality by this project and related activities.

The information required has been collected through primary surveys and secondary sources.

3.5.1 Methodology

Reconnaissance survey was undertaken and monitoring locations were finalized based on:

- Drainage pattern;
- Location of residential areas representing different activities/likely impact areas; and
- Likely areas, which can represent baseline conditions.



Six (6) ground water and two (2) surface water samples covering 10-km radial distance were examined for physio- chemical, heavy metals and bacteriological parameters in order to assess the effect of industrial and other activities on surface and ground water. The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Waste water published by American Public Health Association (APHA).

Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1-ml HNO₃. Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality status in the study area. Parameters like temperature, Dissolved Oxygen (DO) and pH were analyzed at the time of sample collection.

3.5.2 Water Sampling Locations

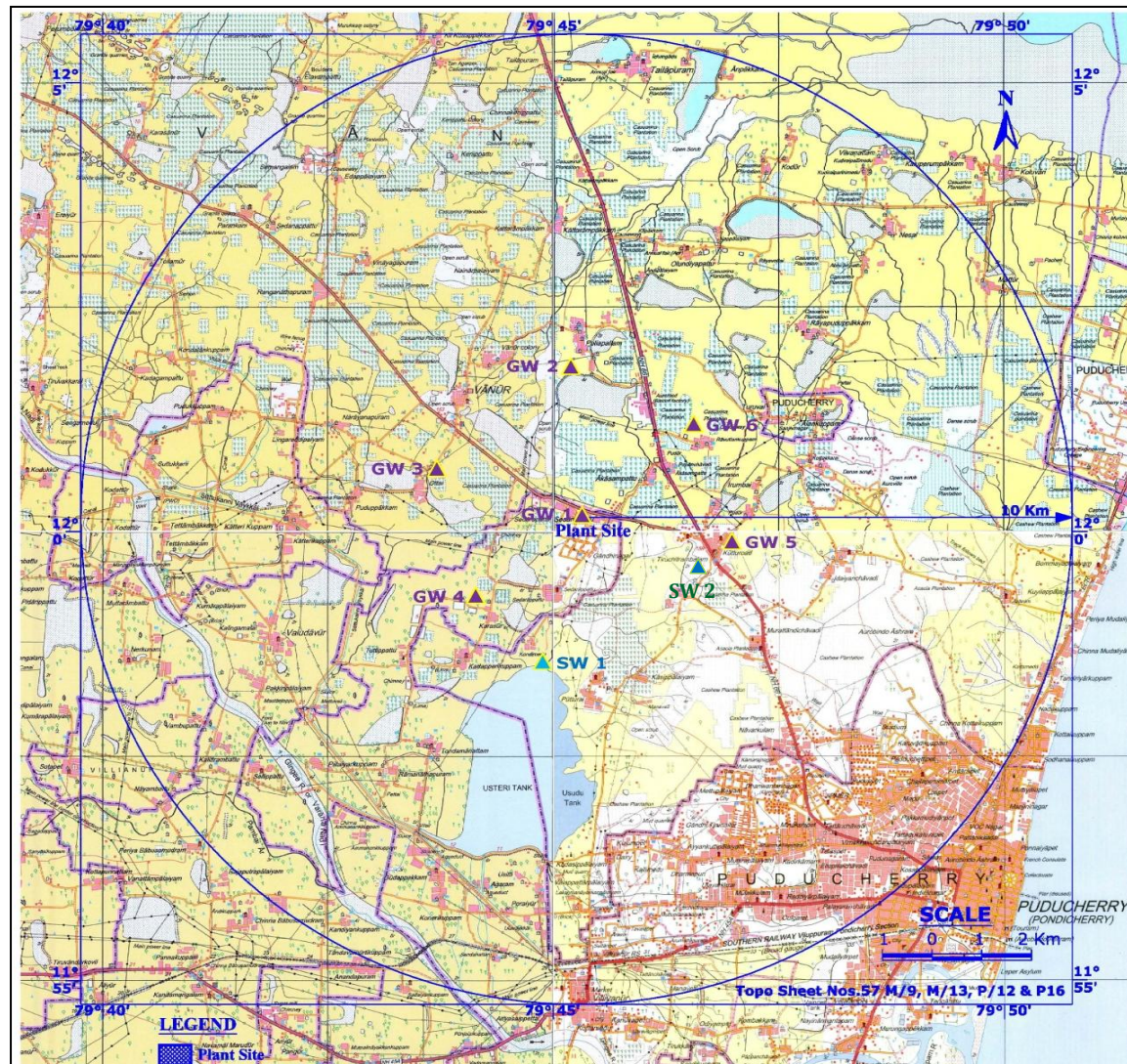
Water samples were taken as grab samples and were analyzed for various parameters to compare with the standards for drinking water as per IS: 10500-2012. The water sampling locations are identified in **Table-3.9** and shown in **Figure-3.12**.

**TABLE - 3.9
DETAILS OF WATER SAMPLING LOCATIONS**

Code	Location	Distance from Plant Boundary (km)	Direction w.r.t. Plant Boundary
Ground Water			
GW1	Project site	---	---
GW2	Puliapallam	3.1	North
GW3	Pudupakkam	2.9	WNW
GW4	Karasur	2.6	SW
GW5	Kutturoad	2.8	ESE
GW6	Irumbai	3.0	ENE
Surface Water			
SW1	Usudu tank	3.4	SSW
SW2	Thiruchitrabalam tank	2.3	ESE

3.5.3 Presentation of Results

The results of the ground water and surface water quality monitored during the study period are given in **Table 3.10 (a), (b)** and **Table-3.11**.



Site	Location	Distance w.r.t. site
GW1	Plant Site (Pondicherry)	---
GW2	Puliapallam	3.1 km, North
GW3	Pudupakkam	2.9 km, WNW
GW4	Karasur	2.6 km, SW
GW5	Kutturoad	2.8 km, ESE
GW6	Irumbai	3.0 km, ENE
SW1	Usudu Tank	3.2 km, South
SW2	Thiruchitrabalam Tank	2.3 km, ESE

**FIGURE-3.12
WATER SAMPLING LOCATIONS**



**TABLE - 3.10 (a)
GROUND WATER QUALITY**

Sr. No.	Parameters	Unit	Limits as per IS: 10500	GW1	GW2	GW3
1	pH	-	6.5-8.5 (N.R.)	7.9	8.1	8.5
2	Colour	Pt-Co	5 (25)	2	1	3
3	Taste	-	Agreeable	Ag	Ag	Ag
4	Odour	-	U.O.	UO	UO	UO
5	Conductivity	µs/cm	\$	1097	1088	1127
6	Turbidity	NTU	5(10)	2	3	4
7	TDS	mg/l	500(2000)	669	653	678
8	Total Hardness	mg/l	300(600)	310	308	316
9	Total Alkalinity	mg/l	200(600)	42	36	48
10	Calcium as Ca	mg/l	75(200)	32.5	26.8	33.6
11	Magnesium as Mg	mg/l	30(100)	9.2	6.3	9.7
12	Residual Free Chlorine	mg/l	0.2 Min	<0.2	<0.2	<0.2
13	Boron	mg/l	1	0.04	0.03	0.03
14	Chloride as Cl	mg/l	250(1000)	99	106	142
15	Sulphate as SO ₄	mg/l	200(400)	54	42	56
16	Fluoride as F	mg/l	1.0(1.5)	0.6	0.5	0.2
17	Nitrate as NO ₃	mg/l	45(NR)	1.3	1.0	0.4
18	Sodium as Na	mg/l	\$	28.1	19.7	29.7
19	Potassium as K	mg/l	\$	2.6	2.4	1.8
20	Phenolic Compounds	mg/l	0.001	<0.001	<0.001	<0.001
21	Cyanide	mg/l	0.05(NR)	<0.02	<0.02	<0.02
22	Anionic Detergents	mg/l	0.2(1.0)	<0.2	<0.2	<0.2
23	Mineral Oil	mg/l	0.01(0.03)	<0.01	<0.01	<0.01
24	Cadmium as Cd	mg/l	0.01(NR)	<0.01	<0.01	<0.01
25	Arsenic as As	mg/l	0.01(NR)	<0.01	<0.01	<0.01
26	Copper as Cu	mg/l	0.05(1.5)	<0.01	<0.01	<0.01
27	Lead as Pb	mg/l	0.05(NR)	<0.01	<0.01	0.07
28	Manganese as Mn	mg/l	0.1(0.3)	<0.01	<0.01	<0.01
29	Iron as Fe	mg/l	0.3(1.0)	<0.01	0.02	0.02
30	Chromium as Cr ₆₊	mg/l	0.05(NR)	<0.05	<0.05	<0.05
31	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	5(15)	0.02	0.01	0.04
33	Aluminium as Al	mg/l	0.03(0.2)	<0.01	<0.01	<0.01
34	Mercury as Hg	mg/l	0.001(NR)	<0.001	<0.001	<0.001
35	Pesticides	mg/l	Absent	Absent	Absent	Absent
36	E.Coli	MPN/100 ml	Absent	Absent	Absent	Absent
37	Total Coliforms	MPN/100 ml	10	<2	<2	<2

Note: (\$) Indicates no limits have been specified. UO-Un objectionable NR- No Relaxation



**TABLE - 3.10 (b)
GROUND WATER QUALITY**

Sr. No.	Parameters	Unit	Limits as per IS: 10500	GW4	GW5	GW6
1	pH	-	6.5-8.5 (N.R.)	7.8	7.7	7.8
2	Colour	Pt-Co	5 (25)	1	2	2
3	Taste	-	Agreeable	Ag	Ag	Ag
4	Odour	-	U.O.	UO	UO	UO
5	Conductivity	µs/cm	\$	1170	1120	896
6	Turbidity	NTU	5 (10)	2	1	2
7	TDS	mg/l	500 (2000)	714	673	538
8	Total Hardness	mg/l	300 (600)	336	400	200
9	Total Alkalinity	mg/l	200 (600)	52	56	34
10	Calcium as Ca	mg/l	75(200)	39.2	45.2	25.2
11	Magnesium as Mg	mg/l	30(100)	11.2	11.8	2.9
12	Residual Free Chlorine	mg/l	0.2 Min	<0.2	<0.2	<0.2
13	Boron	mg/l	1	0.03	0.04	0.02
14	Chloride as Cl	mg/l	250(1000)	128	174	120
15	Sulphate as SO ₄	mg/l	200(400)	47	48	38
16	Fluoride as F	mg/l	1.0(1.5)	0.7	0.5	0.5
17	Nitrate as NO ₃	mg/l	45(NR)	14	30	1.3
18	Sodium as Na	mg/l	\$	38.3	41.2	17.6
19	Potassium as K	mg/l	\$	5.8	6.1	4.7
20	Phenolic Compounds	mg/l	0.001	<0.001	<0.001	<0.001
21	Cyanide	mg/l	0.05(NR)	<0.02	<0.02	<0.02
22	Anionic Detergents	mg/l	0.2(1.0)	<0.2	<0.2	<0.2
23	Mineral Oil	mg/l	0.01(0.03)	<0.01	<0.01	<0.01
24	Cadmium as Cd	mg/l	0.01(NR)	<0.01	<0.01	<0.01
25	Arsenic as As	mg/l	0.01(NR)	<0.01	<0.01	<0.01
26	Copper as Cu	mg/l	0.05(1.5)	<0.01	<0.01	<0.01
27	Lead as Pb	mg/l	0.05(NR)	0.03	0.4	0.2
28	Manganese as Mn	mg/l	0.1(0.3)	<0.01	<0.01	<0.01
29	Iron as Fe	mg/l	0.3(1.0)	<0.01	<0.01	<0.01
30	Chromium as Cr ⁶⁺	mg/l	0.05(NR)	<0.05	<0.05	<0.05
31	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	5(15)	0.01	0.06	0.05
33	Aluminium as Al	mg/l	0.03(0.2)	<0.01	<0.01	<0.01
34	Mercury as Hg	mg/l	0.001(NR)	<0.001	<0.001	<0.001
35	Pesticides	mg/l	Absent	Absent	Absent	Absent
36	E.Coli	MPN/100 ml	Absent	Absent	Absent	Absent
37	Total Coliforms	MPN/100 ml	10	<2	<2	<2

Note: (\$) Indicates no limits have been specified. UO-Un objectionable

NR- No Relaxation

3.5.3.1 Ground Water Quality

The analysis results indicate that the pH ranges in between 7.7 to 8.5, which is well within the specified standard of 6.5 to 8.5. The Total Dissolved Solids (TDS) concentration are found to be ranging in between 538 and 714 mg/l and found to be within the permissible limits at all the sampling locations. Total hardness was observed to be ranging from 200 to



400 mg/l. The hardness was found to be below the permissible limits of 600 mg/l at all locations.

Chlorides at all the locations were within the permissible limit, ranging in between 99.0 to 174 mg/l. Fluorides were observed to be ranging in between 0.2 to 0.7 mg/l and are found to be within the permissible limit. Nitrates are found to be in range of 0.4 to 30.0 mg/l. Bacteriological studies reveal that no *E.coli* bacteria are present in the samples. The heavy metal contents were observed to be below detectable limits except in Zinc content where it ranges between 0.01 mg/l and 0.06 mg/l.

**TABLE - 3.11
SURFACE WATER QUALITY**

Sr. No.	Parameters	Units	SW1	SW2
1	PH	-	7.4	7.6
2	Colour	Hazen	2	2
3	Conductivity	μS/cm	270	380
4	Dissolved Oxygen	mg/l	6.0	6.2
5	BOD (5 days at 20°C)	mg/l	<3.0	<4.0
6	Total Dissolved Solids	mg/l	165	201
7	Total Hardness	mg/l	116	162
8	Chloride as Cl	mg/l	36	39
9	Fluorides as F ⁻	mg/l	0.1	0.1
10	Sulphate as SO ₄ ⁻	mg/l	10.2	14.2
11	Alkalinity	mg/l	24	32
12	Nitrates as NO ₃	mg/l	0.4	0.4
13	Cyanides as CN	mg/l	<0.02	<0.02
14	Calcium as Ca	mg/l	12	14
15	Magnesium as Mg	mg/l	3.5	4.6
16	Sodium as Na	mg/l	2.6	4.2
17	Potassium as K	mg/l	3.1	4.4
18	Iron as Fe	mg/l	0.01	0.01
19	Chromium as Cr	mg/l	<0.05	<0.05
20	Cadmium as Cd	mg/l	<0.01	<0.01
21	Lead as Pb	mg/l	<0.01	<0.01
22	Copper as Cu	mg/l	<0.01	<0.01
23	Arsenic as As	mg/l	<0.01	<0.01
24	Selenium as Se	mg/l	<0.01	<0.01
25	Phenolics as C ₆ H ₅ Oh	mg/l	<0.001	<0.001
26	Zinc as Zn	mg/l	<0.01	<0.01
27	Mercury as Hg	mg/l	<0.001	<0.001
28	Aluminium as Al	mg/l	<0.01	<0.01
29	Anionic detergents as MBAS	mg/l	<0.1	<0.1
30	Oil and grease	mg/l	<0.01	<0.01
31	Sodium Absorption Ratio	-	0.2	0.2
32	Insecticides	mg/l	Absent	Absent
33	Coliform Organisms	MPN/100 ml	<2	<2

Note: \$ - Indicates limits not specified as per IS code



3.5.3.2 Surface Water Quality

The analysis results indicate that pH ranges in between 7.4 to 7.6, which is well within the specified standard 6.5-8.5. The maximum pH was observed at Thiruchitrabalam Tank (SW2) and the minimum pH of 7.4 was observed at Osudu Lake (SW1). The TDS was observed to be in the range of 165 to 201 mg/l. Dissolved Oxygen was observed to be in the range of 6.0 to 6.2 mg/l. The Chlorides were found to be between 36.0 to 39.0 mg/l. The Heavy metal content is below detectable limits.

3.6 Soil Characteristics

It is essential to determine the potential of soil in the area and identify the current impacts of urbanization and industrialization on soil quality and also predict impacts, which may arise due to the plant operations. Accordingly, a study of assessment on the baseline soil quality has been carried out.

3.6.1 Data Generation

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the project area representing various land use conditions. The physical, chemical and heavy metal concentrations were determined. The samples were collected by ramming a core-cutter into the soil upto a depth of 90 cm. The present study of the soil profile establishes the baseline characteristics and this will help in future in identifying the incremental concentrations if any, due to the operation of the plant. The sampling locations have been identified with the following objectives:

- To determine the baseline soil characteristics of the study area;
- To determine the impact of industrialization on soil characteristics; and
- To determine the impact on soils more importantly from agricultural productivity point of view.

Six locations within 10-km radius of the site boundary were selected for soil sampling. At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and were homogenized. This is in line with IS: 2720 and Methods of Soil Analysis, Part-1, 2nd edition, 1986 of American Society for Agronomy and Soil Science Society of America. The homogenized samples were analyzed for physical and chemical characteristics.

The samples have been analyzed as per the established scientific methods for physico-chemical parameters. The heavy metals have been analyzed by using Atomic Absorption Spectrophotometer and Inductive Coupled Plasma Analyzer.

The details of the sampling locations are given in **Table-3.12** and locations are depicted in **Figure-3.13**.



**TABLE - 3.12
DETAILS OF SOIL SAMPLING LOCATIONS**

Code No	Location	Distance from Plant Boundary (km)	Direction w.r.t Plant Boundary
S1	Plant site	---	---
S2	Puliapallam	3.1	North
S3	Pudupakkam	2.9	WNW
S4	Sedarapet	1.6	SSW
S5	Kutturoad	2.8	ESE
S6	Irumbai	3.0	ENE

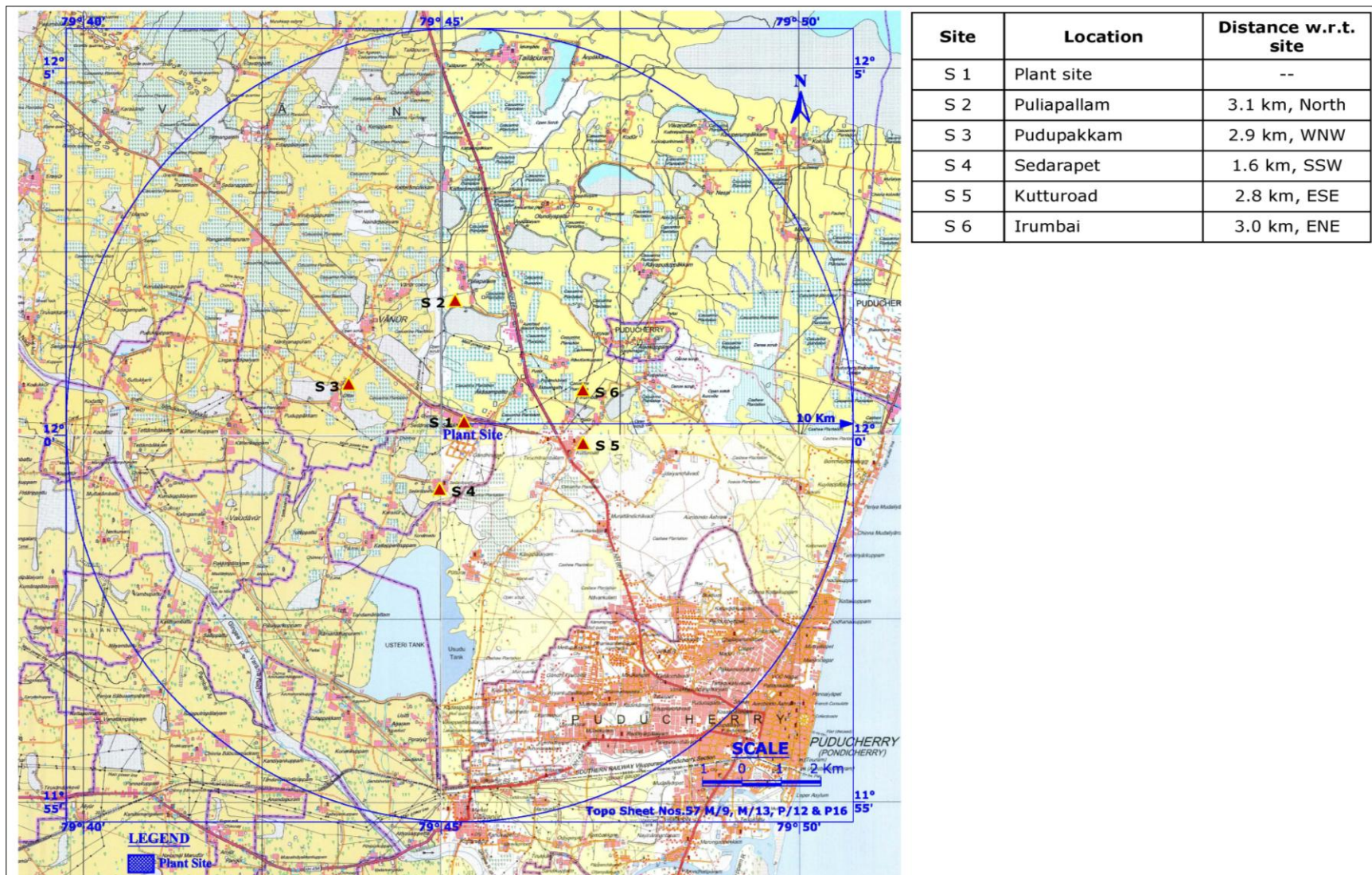


**FIGURE – 3.13
SOIL SAMPLING LOCATIONS**



3.6.2 Baseline Soil Status

The soil quality at all the locations during the study period is tabulated in **Table-3.13**. The results are compared with standard classification given in **Table-3.14**.

TABLE - 3.13
SOIL ANALYSIS RESULTS

Sr. No.	Parameter	UOM	S1	S2	S3	S4	S5	S6
1	pH	---	7.5	7.5	7.8	8.1	7	7.8
2	Conductivity	μS/cm	270	275	747	320	183	501
3	Texture	---	SC	SC	SC	SC	SC	SC
4	Sand	%	44	42	31	44	39	46
5	Silt	%	46	46	36	45	47	48
6	Clay	%	10	12	33	11	14	6
7	Sodium as Na	mg/kg	48.5	84.2	265	120	72.6	128
8	Potassium as K	mg/Kg	137.7	68.3	55.2	131.1	69.6	75.4
9	Organic Carbon	%	0.34	0.21	0.64	0.27	0.32	0.39
10	Organic Matter	%	0.59	0.36	1.11	0.46	0.55	0.68
11	Water Soluble Chloride	mg/kg	100	67.2	319	83.9	50.2	167
12	Water Soluble Sulphate	mg/kg	20.6	16.7	28.5	21	29.9	135
13	Available nitrogen	Kg/ha	74.5	38.2	79.2	57.6	63.4	78.5
14	Available phosphorus	Kg/ha	32.5	46.3	28.1	33.2	40.6	39.8
15	Available potassium	Kg/ha	155	140	187	164	178	176
16	Aluminum as Al	%	2.38	1.96	2.42	3.02	2.46	2.86
17	Iron as Fe	%	0.82	0.3	1.12	0.82	0.35	0.7
18	Boron as B	ppm	4.5	10.5	11.4	9.4	11.3	10.6
19	Manganese as Mn	ppm	164	126	630	164	91.5	136
20	Zinc as Zn	ppm	10.5	10.4	11.4	9.4	11.3	15.8
21	Sodium Absorption Ratio	-	0.22	0.27	0.47	0.28	0.32	0.32
22	Calcium as Ca	mg/Kg	515	1024	4091	2517	597	1799
23	Magnesium as Mg	mg/Kg	120	263	483	194	266	340

It has been observed that the pH of the soil in the study area ranges from 7.0-8.1. The maximum pH value of 8.1 was observed at Sedarpet (S4) and the minimum value of 7.0 was observed at Kutturoad (S5). The Electrical Conductivity was observed to be in the range of 183 - 747 μS/cm, the maximum observed at Pudupakkam (S3) and the minimum observed in the Kutturoad (S5).

The Nitrogen values range between 38.2 – 79.2 kg/ha. The Nitrogen content in the study area falls in "very less" to "less" category. The Phosphorus values range between 28.1 – 46.3 kg/ha, indicating that the Phosphorus content in the study area is "less" to "medium" category. The Potassium values range between 140 – 187 kg/ha. The Potassium content in the study area falls in "less" to "medium" category. The chlorides were found to be in the range of 50.2 – 319 mg/kg.

On the basis of chemical analysis of soils, the soils can be classified as per standard soil classification and is found to be less to medium in nutrients category and with application of supplementary nutrients the soils can give good crop productivity.



**TABLE - 3.14
STANDARD SOIL CLASSIFICATION**

Sr. No.	Soil Test	Classification
1	pH	<4.5 Extremely acidic 4.51- 5.50 Very strongly acidic 5.51-6.00 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity Electrical Conductivity (mmhos/cm) (1ppm = 640 mmho/cm)	Upto 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Organic Carbon (%)	Upto 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (Kg/ha)	Upto 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (Kg/ha)	Upto 15 very less 16-30 less 31-50 medium 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potash (Kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Hand Book of Agriculture, ICAR, New Delhi

3.7 Noise Level Survey

The main objective of noise monitoring in the study area is to assess the baseline noise and assess the impact of the total noise expected to be generated by proposed plant activity.

3.7.1 Identification of Sampling Locations

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noise at different noise generating sources has been identified based on the residential, industrial and commercial activities in the area. The noise monitoring locations are given in **Table - 3.15** and depicted in **Figure - 3.14**.

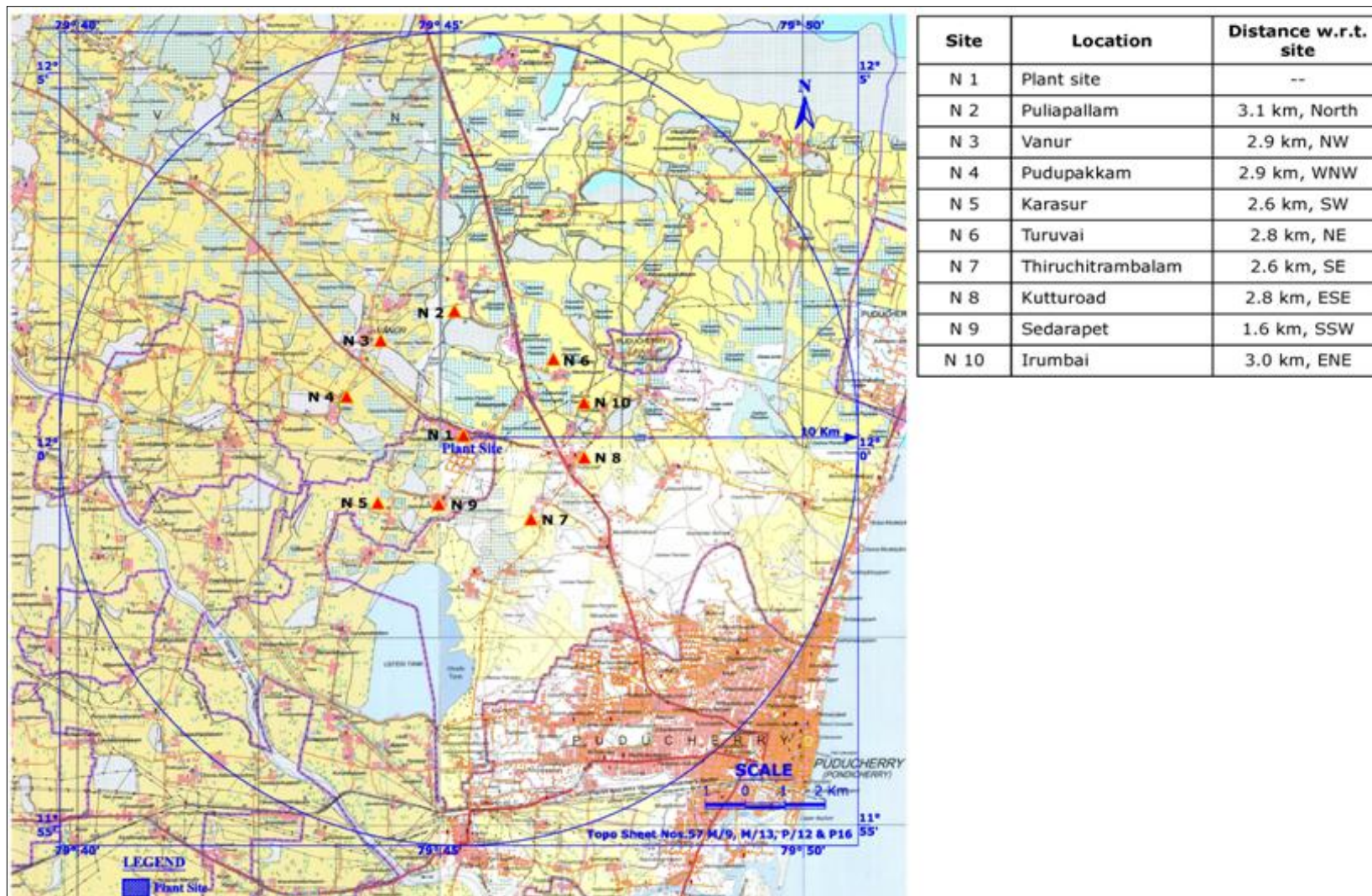


**FIGURE-3.14
NOISE MONITORING LOCATIONS**



**TABLE - 3.15
DETAILS OF NOISE MONITORING LOCATIONS**

Code No	Location	Distance w.r.t. Plant site (Km)	Direction w.r.t. Plant site
N1	Project Site	---	---
N2	Puliapallam	3.1	North
N3	Vanur	2.9	NW
N4	Pudupakkam	2.9	WNW
N5	Karasur	2.6	SW
N6	Turuvai	2.8	NE
N7	Thiruchitrambalam	2.6	SE
N8	Kutturoad	2.8	ESE
N9	Sedarapet	1.6	SSW
N10	Irumbai	3.0	ENE

3.7.2 Methodology of Data Generation

Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hours. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations in the study area.

The noise levels were monitored on working days only and Saturdays, Sundays and public holidays were excluded. During each hour L_{eq} were directly computed by the instrument based on the sound pressure levels. L_{day} (L_d), L_{night} (L_n) and L_{dn} values were computed using corresponding hourly L_{eq} of day and night respectively. Monitoring was carried out at 'A' response and fast mode.

3.7.3 Presentation of Results

The statistical analysis is done for measured noise levels at ten (10) locations. The parameters are analyzed for L_{10} , L_{50} , L_{90} , L_{eq} , L_{day} , L_{night} , and L_{dn} . The statistical analysis results are given in **Table - 3.16**.

**TABLE - 3.16
NOISE LEVELS [dB (A)] IN THE STUDY AREA**

Code No	Location	L_{10}	L_{50}	L_{90}	L_{eq}	L_{day}	L_{night}	L_{dn}
N1	Project Site	60.3	56.7	52.9	57.6	58.5	54.7	61.9
N2	Puliapallam	54.9	48.2	42.9	50.6	53.3	41.7	52.7
N3	Vanur	51.2	46.4	42.8	47.6	49.7	43.9	51.8
N4	Pudupakkam	51.3	47.4	43.5	48.4	49.3	44.7	52.1
N5	Karasur	51.2	46.7	43.3	47.7	49.7	44.8	52.3
N6	Turuvai	53.6	49.1	44.6	50.4	49.3	41.9	50.4
N7	Thiruchitrambalam	52.2	46.1	42.9	47.6	47.2	40.1	48.5
N8	Kutturoad	47.3	43.1	39.2	44.2	45.2	40.8	48.2
N9	Sedarapet	49.4	45.1	42.0	46.7	47.6	43.8	51.0
N10	Irumbai	50.6	46.1	42.7	47.1	49.1	44.2	51.7



- **Daytime Noise Levels (L_{day})**

Industrial Zone: The daytime noise levels in the industrial location was observed to be 58.5 dB (A). The noise level is below the permissible limit of 75 dB (A).

Residential Zone: The daytime noise levels in all the residential locations were observed to be in the range of 45.2 dB (A) to 53.3 dB (A). The noise levels at all the locations were below the permissible limits of 55 dB (A).

- **Night Noise Levels (L_{night})**

Industrial Zone: The nighttime noise levels in all the industrial locations were observed to be 54.7 dB (A) which is below the permissible limit of 70 dB (A).

Residential & other Zone: The nighttime noise levels in all the residential locations were observed to be in the range of 40.1 dB (A) to 44.8 dB (A). The noise levels at all the locations were below the permissible limit of 45 dB (A).

3.8 Ecological Studies

3.8.1 Introduction

Ecological evaluation aims at developing and applying methodologies to assess the relevance of an area for nature conservation. As such, it is to support the assessment of the impact of a proposed development by providing guidance on how to describe the ecological features within the area affected, how to value them, and how to predict the value losses caused by the development. The evaluation of the ecological significance of an area can be undertaken from different perspectives and consequently with different objectives. One of such perspectives focuses on the conservation of the biological diversity or biodiversity. Among the human activities that pose the highest threat to the conservation of biodiversity, the developmental projects in particular are very important. Such projects represent artificial elements that cut through the landscape and interfere with the natural habitat and its conditions by emissions that may be solid, liquid and/or gaseous. This in turn influences the abundance and distribution of plant and animal species, i.e., the biodiversity of the area is impacted.

Most of the background data needs to be acquired from the governmental agencies or the scientific literature. This information is typically complemented by field visit, site surveys and sample collection. The description of the actual ecological assessment provided by the ecological baseline study serves to set a reference for the subsequent impact analysis. Moreover, it helps decision-makers and EIA reviewers to become familiar with the environmental features and the needs of the study area.

3.8.2 Objectives of the Study

The present study was undertaken with the following objectives to assess both terrestrial and aquatic habitats of the study area:

- To assess the nature and distribution of vegetation in and around the existing project site.
- To assess the fauna in the study area;



- To understand the ecology of the water bodies;
- To ascertain the migratory routes of fauna, presence of breeding grounds and sensitive habitats in the study area, if any;
- To assess the presence of protected areas in the study area;
- To review the information from secondary sources and discuss the issues of concern with the relevant authority and stakeholders;
- Impact prediction based on primary and secondary data sources to formulate mitigation measures.

3.8.3 Methodology

To achieve the above objectives a detailed study of the area was undertaken with the site as its centre. The different methods adopted were as follows:

- Generation of primary data by undertaking systematic ecological studies in the study area;
- Primary data collection for flora through random sampling method for trees, shrubs and herbs from the selected locations to know the vegetation cover qualitatively.
- To spot the fauna in the study area and also to identify the fauna by secondary indicators such as pugmarks, scats, fecal pellets, calls and other signs.
- For ecological information, the secondary sources such as local officials, villagers and other stakeholders were interviewed.
- Sourcing secondary data with respect to the study area from published literature.

The list of ecological biodiversity sampling locations in the study area is presented in **Table-3.17** and depicted in **Figure-3.15**.

TABLE - 3.17
LIST OF ECOLOGICAL SAMPLING LOCATIONS

Code	Name of the Locations	Distance from Plant Site (Km)	Direction w.r.t. Plant Site
E-1	Osudu Bird Sanctuary	3.2	South
E-2	Gingee River	8.6	SW
E-3	Thiruchitrabalam	2.3	ESE
E-4	Irumbai	4.0	ENE

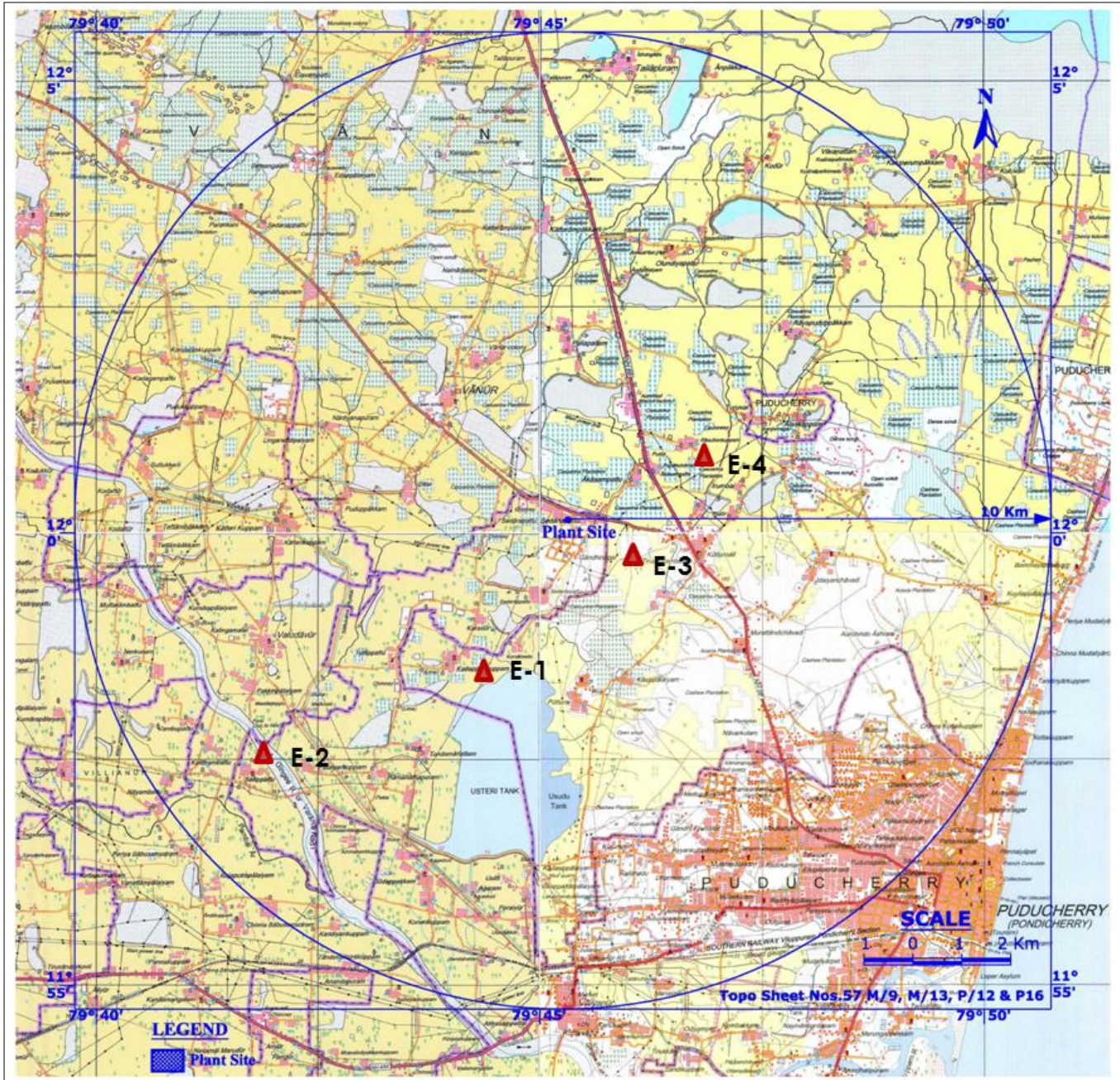


**FIGURE-3.15
ECOLOGICAL SAMPLING LOCATIONS**



3.8.4 Floristic Richness

- **Cryptogamic Vegetation**

The area shows many algae, fungi, bryophytes and ferns. Algae are present in aquatic bodies or in marshy places. Fungi, particularly from ascomycetes and basidiomycetes are located on ground or epiphytically. Lichens of crustose, foliose and fruticose types are present on different substrates (Lichens, Ascomycetes and Basidiomycetes could be observed near hilly terrain and moist areas near villages). Bryophytes occur in wet areas and occasionally on barks of trees and old walls of houses. The commonly observed in this are *Funaria sp* and *Polypodium sp*. Fern flora of the study area is insignificant. The aquatic weeds *Marselia quadrifolia* and *Salvinia* were observed near small ponds in agricultural fields.

- **Life Form Spectrum**

Raunkiaer defined life forms as the sum of adaptations of plants to climate. Braun-Blanquet (1951), whose system is adapted in this study, modified the Raunkiaer's system. Following five of the ten classes created by Braun-Blanquet are present in the study area.

- Phanerophytes : Shrubs and trees
- Therophytes : Annuals including ferns
- Hydrophytes : Water plants except plankton
- Hemicryptophytes : Plants with perennial shoots and buds close to surface
- Geophytes : Plants with perennating parts buried in substratum

322 plant species (except algae, fungi and bryophytes) were recorded from the study area and are presented in **Annexure-VI**. Their analysis revealed the following **Table - 3.18**.

TABLE - 3.18
CLASS WISE DISTRIBUTION OF PLANT SPECIES IN THE STUDY AREA

Type of Species	Number	% of Total
Phanerophytes (P)	140	43.4
Therophytes (T)	114	35.4
Hemicryptophytes (He)	43	13.4
Hydrophytes (H)	16	5.0
Geophytes (G)	9	2.8
Total	322	100

- **Comments on the Life Form Spectrum**

Life form spectrum is a reflection of plant community. A plant community is governed by several factors like climatic, edaphic, topographic and biotic. Even local variations in environment affect components of plant community. Among all these factors, it is life form spectrum of an area which reflects the prevailing climatic conditions.

In the study area, maximum number of species are phanerophytes (43.47%) followed by therophytes (35.40%). These classes are followed by hemicryptophytes and hydrophytes. Geophytes were found in very few numbers. Presence of large number of phanerophytes (shrubs and trees) and therophytes (Annuals or herbaceous vegetation) indicates semiarid to tropical vegetational structure. The area shows a rich gene pool of perennial shrubs and trees. This indicates a potentially good area for their growth.



Hemicryptophytes (predominantly grasses and sedges) were found to be significant in the area. These indicate fertile and wet soil in upper layer of soil profile. Hydrophytes were present in both the seasonal or perennial water bodies.

Thus based on life form spectrum, the climate is tropical and receives adequate rainfall. However, the soils in the area have poor retention of moisture. The area also witnesses fairly long dry spells, with heavy fluctuations in temperature. This could be responsible for the present life form spectrum.

• **Conclusions of Terrestrial Ecology**

The floral structure in the study area is uniform in nature. The herbaceous flora like *Parthenium hysterophorus*, *Mimusops pudica*, *Physalis minima*, *Leucas stellifeta*, *Jatropha*, *Rungia repens*, *Mangifera indica*, *Borassus flabellifera*, *Cocos nucifera* are dominant floral element from herbaceous and perennial vegetation. The large number of herbaceous members is due to heavy rainfall combined with moderate temperatures and fertility of soil.

3.8.5 Endangered Plants

The area did not record the presence of any critically threatened or endangered species. The records of Botanical Survey of India and Forest department also did not indicate presence of any high endemic or vulnerable species in this area.

3.8.6 Wildlife Studies

Field studies conducted to assess faunal components in study area and their conservation status as Wildlife protection Act, 1972 are presented in **Table - 3.19**. On the basis of field studies and secondary sources, there are faunal species (Sch-I of Wildlife Protection Act, 1972) present in the study area.

3.8.6.1 Primary Survey

Primary fauna studies were conducted during study and details are presented in Table-3.19. A number of local migratory and non-migratory birds arrive and depart at different parts of the season adding their share to the noise, bustle and color of the bird spectacle on the tank. Among these, the recognized are common kite, rock pigeon, the black winged stilt, pond heron and few other ducks.

3.8.6.2 Endangered Animals

A comprehensive Central Legislation namely Wild Life (Protection) Act was enforced in 1972 to provide protection to wild animals. Schedule-I of this act contains the list of rare and endangered species, which are completely protected throughout the country.

The list of wild animals and their conservation status as per Wild Life Act (1972) are presented in **Table - 3.19**. Faunal studies, primary survey were conducted to assess the faunal components in selected villages, nearby ponds, lakes and in the vicinity of commercial plantations.



**TABLE - 3.19
FAUNA AND THEIR CONSERVATION STATUS FROM STUDY AREA**

Sr. No.	Scientific Name	English Name/ Local Name	Conservation status as per Wild Life Act (1972)
	Aves		
1	<i>Quills contronix</i>	Grey quail	Sch-IV
2	<i>Corvus corvus</i>	Jungle crow	Sch-IV
3	<i>Corvus splendens</i>	House crow	Sch-IV
4	<i>Turdoides striatus</i>	White headed babler	Sch-IV
5	<i>Aegithina tiphia</i>	Iora	Sch-IV
6	<i>Pycnonotus cafer</i>	Red vented bulbul	Sch-IV
7	<i>Pycnonotus jokokus</i>	White browed Bulbul	Sch-IV
8	<i>Saxicoloides fulicata</i>	Indian robin	Sch-IV
9	<i>Columbus livia</i>	Blue Rock Pigeon	Sch-V
10	<i>Copsychus saularis</i>	Magpie Robin	Sch-IV
11	<i>Tchitrea paradisi</i>	Paradise Flycatcher	Sch-IV
12	<i>Tephrodornis pondiceraianus</i>	Common Wood shrike	Sch-IV
13	<i>Lalage sykesi</i>	Black headed cochoo Shrike	Sch-IV
14	<i>Artamus fuscus</i>	Ashy Swallow Shrike	Sch-IV
15	<i>Dicrurus macrocerus</i>	Black Drongo	Sch-IV
16	<i>Dicrurus longicaudatus</i>	Grey Drongo	Sch-IV
17	<i>Oriolus oriolus</i>	Indian Oriole	Sch-IV
18	<i>Temenuchus pagodarum</i>	Brahmny Myna	Sch-IV
19	<i>Acridotheres tristis</i>	Common myna	Sch-IV
20	<i>Ploceus philippines</i>	Weaver bird	Sch-IV
21	<i>Uroloncha striata</i>	Spotted munia	Sch-IV
22	<i>Passer domesticus</i>	House Sparrow	Sch-IV
23	<i>Cinnyris asiatica</i>	Purple Sunbird	Sch-IV
24	<i>Brachypternus bengalensis</i>	Malabar Golden Packed wood	Sch-IV
25	<i>Megalaima merulinus</i>	Indian Cuckoo	Sch-IV
26	<i>Hierococys varius</i>	Common Hawk Cuckoo	Sch-IV
27	<i>Eudynamis scolopaceus</i>	Koel	Sch-V
28	<i>Centropus sinensis</i>	Crow Pheasant	Sch-IV
29	<i>Psittacula Krammeri</i>	Rose ringed parakeet	Sch-IV
30	<i>Coracias benghalensis</i>	Indian Roller	Sch-IV
31	<i>Merops orinetalis</i>	Common Bee Eater	Sch-IV
32	<i>Alcedo atthis</i>	Common Kingfisher	Sch-IV
33	<i>Microfus affinis</i>	House swift	Sch-IV
34	<i>Cyprius parvus</i>	Palm swift	Sch-IV
35	<i>Caprimulgus asiaticus</i>	Common Indian Night Jar	Sch-IV
36	<i>Tylo alba</i>	Barn Owl	Sch-IV
37	<i>Haliastur indus</i>	Brahmny kite	Sch-I
38	<i>Milvus migrans</i>	Pariah kite	Sch-I
39	<i>Circus aeruginosus</i>	Marsh harrier	Sch-IV
40	<i>Chalcophaps indica</i>	Emerald Dove	Sch-IV
41	<i>Lobvanella indicus</i>	Redwattled Lapwing	Sch-IV
42	<i>Lobpluvia malabaraica</i>	Yellow wattled lapwing	Sch-IV
43	<i>Anhinga melanogaster</i>	Darter	Sch-V
44	<i>Egretta garzetta</i>	Little Egret	Sch-IV
45	<i>Bubulcus ibis</i>	Cattle Egret	Sch-IV
46	<i>Ardeola grayii</i>	Pond Heron	Sch-IV
47	<i>Sterna albifrons</i>	Indian River Tern	Sch-IV



Sr. No.	Scientific Name	English Name/ Local Name	Conservation status as per Wild Life Act (1972)
48	<i>Galerida malabarica</i>	Malabar Crested Lark	Sch-IV
49	<i>Platalea leucorodia</i>	Eurasian Spoonbill	Sch-I
50	<i>Pandion haliaetus</i>	Osprey	Sch-I
51	<i>Haliaeetus leucogaster</i>	White-bellied sea eagle	Sch-I
52	<i>Pavo cristatus</i>	Indian Peafowl	Sch-I
	Reptiles		
53	<i>Ptyas mucosus</i>	Rat snake	Sch-II
54	<i>Nerodia piscator</i>	Fresh water snake	Sch-III
55	<i>Naja naja</i>	Cobra	Sch-IV
56	<i>Bungarus candidus</i>	Krait	Sch-III
57	<i>Vipera russeli</i>	Viper	Part-II of Sch-II
	Butterflies		
58	<i>Pachliopta hector</i>	Crimson rose	Sch-I
59	<i>Common Pierrot</i>	Castalius rosimon	Sch-I
60	<i>Papilo demoleus</i>	Lime butterfly	-
61	<i>Graphium agamemnos</i>	Tailed jay	-
62	<i>Junonia atlites</i>	Grey pansey	-
63	<i>Juninia almana</i>	Peacock pansey	-
64	<i>Neptis hylas</i>	Common sailor	Sch-IV
65	<i>Parantica aglea</i>	Glassy tiger	Sch-IV
	Amphibian		
66	<i>Rana hexadactyla</i>	Frog	Sch-IV
67	<i>Rana tigrina</i>	Bull frog	Sch-IV
	Mammals		
68	<i>Lepus nigricollis</i>	Black naped Hare	Sch-IV
69	<i>Paradoxurus hermaphroditus</i>	Asian Palm Civet	Sch-II
70	<i>Funambulus palmarum</i>	Three Striped palm Squirrel	Sch-IV
71	<i>Axis axis</i>	Spotted deer	Sch-IV
72	<i>Herpestes edwardii</i>	Common mongoose	Sch-II
73	<i>Bandicota indica</i>	Bandicoot rat	Sch-V
74	<i>Mus sp.</i>	Mice	Sch-V

3.8.7 Aquatic Ecosystems

Protecting the environment and making efficient use of natural resources are two of the most pressing demands in the present stage of social development. The task of preserving the purity of the atmosphere and water basins is of both national and global significance since there are no boundaries to the propagation of anthropogenic contaminants in the water.

The objective of the study is:

- To understand their present biological status; and
- To characterize water bodies with the help of biota.

To meet with these objectives the following methods were followed:

- Generating data by actual field sampling and analysis in these areas through field visits during study period; and



- Interrogating local people so as to get the information for aquatic plants and aquatic animals.

To fulfill these objectives and to understand the present status of aquatic ecosystem, aquatic samples were collected from different regions of the brackish waters areas and also from Usudu which is a fresh water lake in the study area. The aquatic sampling locations are presented in **Table-3.20**.

**TABLE - 3.20
DETAILS OF AQUATIC SAMPLING LOCATIONS**

Code No	Locations	Distance & Direction w.r.t. plant site	Remarks
AE-1	Usudu tank	3.2 km, South	Tank water
AE-2	Sea water near Pillaichavady	11.5 km, ENE	Sea water

3.8.7.1 Methodology Adopted for Aquatic Studies

Plankton samples were collected and analysed as per Standard Methods (APHA, 2002) and the species diversity index was calculated. The details of species diversity index are presented in **Table-3.21**.

**TABLE - 3.21
DIVERSITY INDEX FOR PLANKTON**

Location Code	Name of the Location	Diversity index for Phytoplankton	Diversity index for Zooplankton
AE-1	Usudu tank	2.76	2.42
AE-2	Sea water near Pillaichavady	2.98	2.54

The indices calculated for all three sampling locations indicate that the water bodies in the study area are not polluted due to any industrial and domestic activity. The range of index among the three sampling locations reveals that the water bodies are having broad ecotone boundaries, which indicate gradual changes in the biological quality and the species composition, and these sampling bodies are mesotrophic in nature. The list of planktonic flora and fauna are presented in **Table-3.22**.

**TABLE - 3.22
LIST OF PLANKTON OBSERVED FROM STUDY PERIOD**

Sr.No.	Phytoplankton	Sr. No.	Phytoplankton
1	<i>Chlorella sp</i>	37	<i>Ditylum brightwelli</i>
2	<i>Chlorococcum sp</i>	38	<i>Eucampia</i>
3	<i>Pediastrum duplex</i>	39	<i>Fragilaria oceanica</i>
4	<i>Spirogyra sp</i>	40	<i>Fragillaria</i>
5	<i>Cpsmarium</i>	41	<i>Laundera borealis</i>
6	<i>Cymbella sp</i>	42	<i>Leptocylindrus</i>
7	<i>Euglena sp</i>	43	<i>Licmophora sp</i>
8	<i>Fragillaria sp</i>	44	<i>Navicula sp.</i>
9	<i>Gleocapsa sp</i>	45	<i>Nitzschia sp 1</i>
10	<i>Gomphonema sp</i>	46	<i>Nitzschia sp 2</i>
11	<i>Melosira sp</i>	47	<i>Planktoniella</i>
12	<i>Merismopedia sp</i>	48	<i>Pleurosigma normani</i>



Sr.No.	Phytoplankton	Sr. No.	Phytoplankton
13	<i>Microcystis sp</i>	49	<i>Rhizosolenia sp.</i>
14	<i>Navicula sp</i>	50	<i>Rhizosolenia stolforfothi</i>
15	<i>Nitzschia sp</i>	51	<i>Rhizosolenia alata</i>
16	<i>Oscillatoria sp</i>	52	<i>Rhizosolenia cylindrus</i>
17	<i>Scendesmus sp</i>	53	<i>Rhizosolenia setigera</i>
18	<i>Spirulina sp</i>	54	<i>Rhizosolenia shrubsoleri</i>
19	<i>Tetradron sp</i>	55	<i>Scleletanema costatum</i>
20	<i>Mougthia sp</i>	56	<i>Stephanopyxis</i>
21	<i>Ankistrodesmus falcatus</i>	57	<i>Streptotheca thamensis</i>
22	<i>Aanabaena sp</i>	58	<i>Thalassiothrix</i>
23	<i>Rivularia sp</i>	59	<i>Rhizosolenia stiformis</i>
24	<i>Asterionella japonica</i>	60	<i>Rhizosolenia stolter</i>
25	<i>Biddulphia alternans</i>		Class: Chrysophyceae
26	<i>Biddulphia aurita</i>	61	<i>Chromulina sp</i>
27	<i>Biddulphia mobiliensis</i>		Class :Chlorophyta
28	<i>Biddulphia regia</i>	62	<i>Halosphaera sp</i>
29	<i>Biddulphia sinensis</i>	63	<i>Pyramimonas sp</i>
30	<i>Chaetoceros decipens</i>	64	<i>Rhabdosphaera sp</i>
31	<i>Chaetoceros danicum</i>		Class: Dinophyceae
32	<i>Chaetoceros densum</i>	65	<i>Ceratium sp</i>
33	<i>Coscinodiscus sp</i>	66	<i>Ceratium sp</i>
34	<i>Coscinodiscus</i>	67	<i>Gravidium sp</i>
35	<i>Coscinodiscus lineatus</i>	68	<i>Hemiselmis sp</i>
36	<i>Dictyum</i>	69	<i>Ioschrysis sp</i>

3.9 Land Use Studies

3.9.1 Objectives

The objectives of land use studies are:

- To determine the present land use pattern;
- To analyze the impacts on land use due to the proposed activity in the study area; and
- To give recommendations for optimizing the future land use pattern and associated impacts.

3.9.2 Land-Use Based on Census Data

The land use of the study area has been studied by analyzing the available secondary data such as the District Primary Census Handbook of Pondicherry & Villupuram districts for the year 2011.

For computation of the land use pattern in the study area based on the village-wise land-use data given in the census records, the geographical area of all settlements covered within the study area is considered, though many villages in the peripheries of the circular study area are partially covered. Perfect delineation and quantification of land uses for the partially covered parts of villages in the study area is not possible, hence the entire village area is considered for the study, irrespective of its coverage within the study area circle. The land use is classified into four types - viz., forests, area under cultivation, cultivable waste land and the area not available for cultivation. The land under cultivation is further sub-divided into two types viz. irrigated and un-irrigated. As per the Census records, the study area



measures about 19,146.36 ha. The land use details based on census data are presented in **Table-3.23**. This includes forests, cultivated area, cultivable waste land and the area not available for cultivation. The village wise land use pattern in the study area is given in **Annexure-VIII**.

**TABLE - 3.23
LAND USE PATTERN OF STUDY AREA**

Sr. No.	Particulars of Land use	0-3 km (in ha)	3-7 km (in ha)	7-10 km (in ha)	0-10 km (in ha)
1	Forest Land	0	26.21	75.01	101.22
2	Land under Cultivation				
	a) Irrigated Land	386.64	2447.35	2713.57	5547.56
	b) Un irrigated Land	461.64	3392	3657.45	7511.09
3	Cultivable Waste Land	265.65	428.51	341.18	1035.34
4	Area not available for cultivation	477.95	2061.39	2411.81	4951.15
	Total Area	1591.88	8355.46	9199.02	19146.36

Source: District Primary Census Hand Book – Pondicherry & Vilupuram districts, 2011

3.9.3 Land Use Pattern in Study Area Based on Satellite imagery

Remote sensing satellite imageries were collected and interpreted for the 10-km radius study area for analyzing the Land use pattern. Based on the satellite data, Land use/ Land cover maps have been prepared.

3.9.3.1 Land use/Land Cover classification system

The present Land use / Land cover maps were prepared based on the classification system of National standards. For explanation for each of the Land use category, the details as given in **Table-3.24** were considered.

3.9.3.2 Data Requirements

IRS Resourcesat-2 of LISS IV FX multispectral satellite data was acquired on 29th December 2015 and was used for the mapping and interpretation. Besides, other collateral data available in the form of maps, charts, census records, other reports and especially topographical survey of India maps are used. In addition to this, ground truth survey was also conducted to verify and confirm the ground features.

3.9.3.3 Methodology

The methodology adopted for preparation of Land use/Land cover thematic map is as follows:

- Digital interpretation of IRS Resourcesat-2 LISS IV FX satellite imagery data using ERDAS software programme; and
- Field observations

The methodology adopted for preparation of land use/ land cover thematic map is monoscopic visual interpretation of geo coded scenes of IRS Resourcesat-2 satellite and field observations are taken. The various steps involved in the study are preparatory field work, field survey and post field work.



**TABLE - 3.24
LAND USE/LAND COVER CLASSIFICATION SYSTEM**

Sr. No.	Level-1	Level-2
1	Built-up Land	Town/cities
		Villages
		Institution/Industry/Godown etc
		Plotted Area/Layout
2	Agriculture Land	Double Crop Land/Irrigated Area
		Plantations
		Fallow
3	Forest	Evergreen/Semi evergreen
		Deciduous
		Forest Plantation
4	Wastelands	Rocky/Stony Waste
		Land with /without scrubs
		Saline/sandy & Marshy/swampy
5	Water Bodies	River/Stream
		Lake/Reservoir/Tanks
6	Others	Orchard/Other Plantation
		Shifting cultivation
		Salt Pans, Snow covered/Glacial
		Barren/Vacant Land

3.9.3.4 Pre field Interpretation of Satellite Data

The False Color Composite (FCC) of IRS Resourcesat-2 satellite data were used for pre field interpretation work. Taking the help of toposheets, geology, geomorphology and by using the image elements, the features were identified and the boundaries were delineated roughly. Each feature was identified on image by their image elements like tone, texture, colour, shape, size, pattern and association. A tentative legend in terms of Land Use/Land Cover, physiography and erosion was formulated. The sample areas for field check were selected covering all the physiography, Land use/Land cover feature cum image characteristics.

- Ground Truth Collection

Both toposheets and imagery were taken for field verification and a transverse plan using existing road network was made to cover as many representative sample areas as possible to observe the broad Land use features and to adjust the sample areas according to field conditions. Detailed field observations and investigations were carried out.

- Post Field Work

The base maps of the study area were prepared, with the help of Survey of India toposheets. Preliminary interpreted Land use and the Land cover features boundaries from IRS Resourcesat-2 False Colour Composite were modified in light of field information and the final thematic details were transferred onto the base maps. The final interpreted and classified thematic map was cartographed. The cartographic map was coloured with standard colour coding and detailed description of features with standard symbols were provided. All the classes were noted and marked by the standard legend on the map.



3.9.3.5 Final Output

The final output would be the Land use/Land cover map. Numerals were given different colour code for each category as shown in map. Area estimation of all features of Land use/Land cover categories was noted. The details of various land use pattern are furnished in **Table-3.25**.

3.9.3.6 Observations

The following are the main interpreted Land use / Land cover classes of the study area and their respective areas are given in Sq.km for the month of December 2015.

The thematic map of the study area and land use pattern within 10 km radius based on IRS Resourcesat-2 are shown in **Figure-3.16** and **Figure-3.17** respectively.

- **Built-Up Land**

Total built-up land comprises of 12.6% of settlements/Airports/Mandir and 5.3% of industrial area.

- **Wastelands**

Total waste land of the study area comprises of 3.9% of land with scrubs and 1.4 % of land without scrubs and 0.3% of land under mud quarry.

- **Water Bodies**

The water body area is about 44.588-Sq.km, which is about 14.2 % of the study area.

- **Crop Land**

Total crop land comprises of 39.5% of single crop, 10.2% of double crop and 12.6% of plantation respectively.

TABLE - 3.25
LAND USE PATTERN OF STUDY AREA

Sr.No.	Landuse	Area (Sq. Km)	Percentage (%)
Built-up Land/Other Development			
1	Settlements/Airports/Mandir	39.564	12.6
2	Industrial Area	16.642	5.3
Waste Land			
3	Land with Scrub	12.246	3.9
4	Land without Scrub	4.396	1.4
5	Mud Quarry	0.942	0.3
Water body			
6	Tank/River	44.588	14.2
Crop Land			
7	Single Crop	124.03	39.5
8	Double Crop	32.028	10.2
9	Plantation	39.564	12.6
Total		314	100.0

Source: NRSC, Hyderabad, IRS Resourcesat-2 LISS IV-FX-29th December, 2015

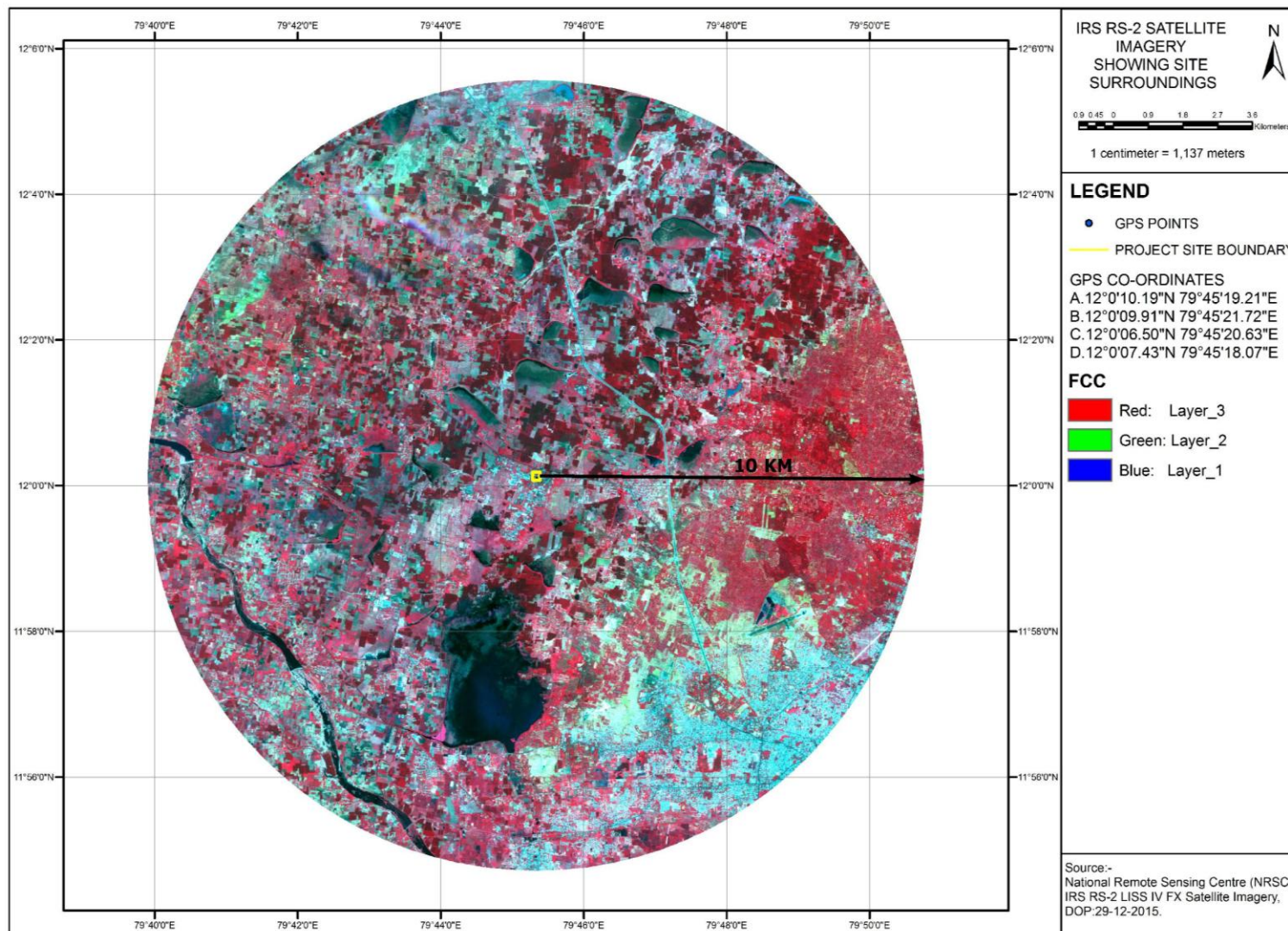


**FIGURE-3.16
SATELLITE IMAGE-STUDY AREA**

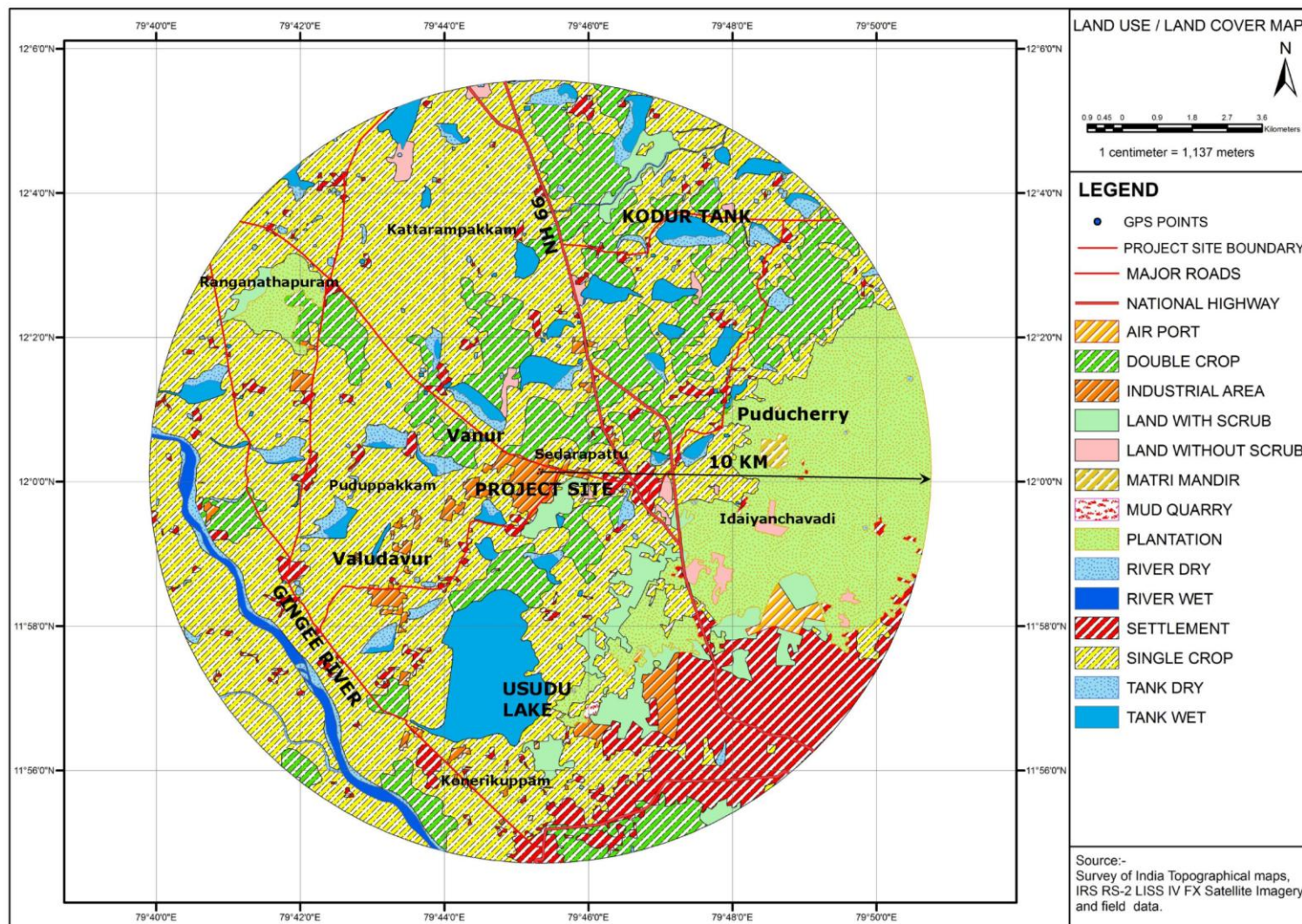


FIGURE-3.17
LANDUSE/LAND COVER MAP BASED ON SATELLITE DATA



3.10 Demography and Socio-Economics

The growth of industrial sectors and infrastructure developments in and around the agriculture dominant areas, villages and towns are bound to create its impact on the socio-economic aspects of the local population. The impacts may be positive or negative depending upon the developmental activity. To assess the impacts on the socio-economics of the local people, it is necessary to study the existing socio-economic status of the local population, which will be helpful for making efforts to further improve the quality of life in the area of study. To study the socio-economic aspects of people in the study area around the project site, the required data has been collected from various secondary sources and supplemented by the primary data generated through the process of a limited door to door socio-economic survey.

3.10.1 Methodology Adopted for the Study

The methodology adopted for the study mainly includes review of published secondary data, such as the District Census Statistics of 2011 for Pondicherry & Villupuram districts within the study area of 10-km radial distance from the periphery of the proposed project site. The village wise demographic data as per 2011 Census is presented in **Annexure-IX**.

3.10.2 Review of Demographic and Socio-Economic Profile – 2011

The sociological aspects of this study include human settlements, demography, social such as scheduled castes and scheduled tribes and literacy levels besides infrastructure facilities available in the study area. The economic aspects include occupational structure of workers. The salient features of the demographic and socio-economic details are described in the following sections.

3.10.3 Demographic Aspects

Distribution of population

As per 2011 census, the study area consists of 6,07,629 persons inhabited in the study area of 10 km radial distance from the periphery of the project site. The distribution of population in the study area is given in **Table-3.26**. The males and females constitute about each 50 % in the study area respectively.

**TABLE - 3.26
DISTRIBUTION OF POPULATION IN THE STUDY AREA**

Particulars	0-3 km	3-7 km	7-10 km	0-10 km
No. of Households	4078	51146	91412	146636
Male population	8498	109699	184652	302849
Female population	8444	108123	188213	304780
Total population	16942	217822	372865	607629
% Males to total population	50	50	50	50
% of Females to total population	50	50	50	50
Average Household Size	4.15	4.26	4.08	4.14

Source: District primary Census Hand Book – Pondicherry & Villupuram districts, 2011

Average Household Size

The study area has an average family size of 4.14 persons per household in 2011. This is nearer to large family size and is in comparison with the other parts of the district.



Sex Ratio

The configuration of male and female indicates that the males and females constitute about each 50% of the total population. The sex ratio i.e. the number of females per 1000 males indirectly reveals certain sociological aspects in relation with the female births, infant mortality among female children and single person family structure, a resultant of migration of industrial workers. The study area on an average has 1007 females per 1000 males.

3.10.4 Social Structure

In the study area about 25.34% population belong to Scheduled Castes (SC) and 0.71% Scheduled tribes (ST) indicating that about 26.05% of the population in the study area belongs to socially weaker sections. The distribution of population in the study area by social structure is shown in **Table-3.27**.

**TABLE - 3.27
DISTRIBUTION OF POPULATION BY SOCIAL STRUCTURE**

Sr. No.	Particulars	0-3 km	3-7 km	7-10 km	0-10 km
1	Scheduled Castes	4659	75979	50898	131536
2	% to total population	27	35	14	25.34
3	Scheduled Tribes	108	2965	452	3525
4	% to total population	1	1	0	0.71
5	Total SC and ST population	4767	78944	51350	135061
6	% total population	28	36	14	26.05
7	Other caste population	12175	138878	321515	472568
8	% to total population	72	64	86	73.95
Total population		16942	217822	372865	607629

Source: District primary Census Hand Book – Pondicherry & Villupuram districts, 2011

3.10.5 Literacy Levels

The study area experiences literacy rate of 73%. The distribution of literate and literacy rate in the study area is given in **Table-3.28**. The male literacy i.e. the percentage of male literate to the total males of the study area works out to be 54%. The female literacy which is an important indication for social changes is observed to be 46 % in the study area as per 2011 census.

**TABLE - 3.28
DISTRIBUTION OF LITERATE AND LITERACY RATES**

Sr. No.	Particulars	0-3km	3-7km	7-10km	0-10km
1	Total literate	12694	145815	289424	447933
2	Male population	8498	109699	184652	302849
3	Female population	8444	108123	188213	304780
4	Average literacy %	75	67	78	73
5	Male literate	6839	81504	151476	239819
6	% To study area literate	54	56	52	54
7	% To Total male population	80	74	82	79
8	Female literate	5855	64311	137948	208114
9	% To study area literate	46	44	48	46
10	% To Total female population	69	59	73	67
Total population		16942	217822	372865	607629

Source: District primary Census Hand Book – Pondicherry & Villupuram districts, 2011



3.10.6 Occupational Structure

The occupational structure of residents in the study area is studied with reference to main workers, marginal workers and non-workers. The main workers include 10 categories of workers defined by the Census Department consisting of cultivators, agricultural laborers, those engaged in live-stock, forestry, fishing, mining and quarrying; manufacturing, processing and repairs in household industry; and other than household industry, construction, trade and commerce, transport and communication and other services.

The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc.; institutional inmates or all other non-workers who do not fall under the above categories.

As per 2011 census records, altogether the main workers population works out to be 41.63 % of the total population. The marginal workers and non-workers constitute 8.0% and 58 % of the total population respectively. The distribution of workers by occupation indicates that the non-workers are the predominant population. The occupational structure of the study area is given in **Table- 3.29**.

**TABLE - 3.29
OCCUPATIONAL STRUCTURE**

Sr. No.	Particulars	0-3km	3-7km	7-10km	0-10km
1	Total Main workers	6581	104407	142066	253054
2	% to total population	39	48	38	41.63
3	Marginal workers	1256	26509	15165	42930
4	% to total population	7	12	4	8
5	Non -workers	10361	113415	230799	354575
6	% to Total population	61	52	62	58
Total population		16942	217822	372865	607629

Source: District primary Census Hand Book – Pondicherry & Villupuram districts, 2011

CHAPTER-4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES



4.0 ANTICIPATED ENVIRONMENTAL IMPACTS

This chapter describes the identification of impacts, appraisal of various impacts, and mitigation measures during construction and operational phases. Also, it describes the action plan for the control of pollution as per CPCB and CREP guidelines.

4.1 Identification of Impacts

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 changed pattern of social and economic activities of surrounding community. The impacts have been assessed for the proposed project assuming that the pollution will continue to remain same till the operation of the stated activity.

The environment management plan is required to ensure sustainable development in the area of the proposed plant. It is to be appreciated that sulphonation process, to a certain extent, is associated with an inevitable negative impact on environment, but the impacts are within limits and can be easily ameliorated to a significant extent through adoption of appropriate mitigative measures.

The construction and operation of the proposed components comprises various activities each of which may have an impact on one or the other environmental parameters. Various impacts during the construction and operation phase on the environmental parameters have been studied to estimate the impact on the environment due to the implementation of the project and are discussed in the subsequent sections.

4.2 Impacts during Construction Phase

This includes the activities related to demolition of existing buildings, if any, establishment activities of the proposed plant and other related structures and installation of equipment.

4.2.1 Land use and Soil Quality

❖ Impact on Land Use

The proposed project will be carried out in a area of 0.907 ha. No clearing of trees/shrubs is required during construction phase as the proposed site is a notified Industrial area. Thus, the overall impact will be beneficial in nature. As the land use of project site is industrial, there will not be any change in the land use classification.

❖ Impact on Soil Quality

No blasting is envisaged for either leveling or foundation work. The proposed construction & erection activities will not result in loss of topsoil. Apart from much localized construction impacts at the project site, no significant adverse impact on soil in the surrounding area is anticipated.

❖ Mitigation Measures

The following mitigation measures shall be adopted for soil and land environment:



- After completion of the construction phase, the surplus earth shall be utilized to fill up the low lying areas, the rubble will be cleared and all un-built surfaces will be reinstated;
- Green belt development and related activities shall be taken up so that plantation will grow to adequate height by the time of plant commissioning;
- Species selected for plantation shall be fast growing and they shall be adaptable to local conditions. Their ability to combat localized pollution is the prime factor for their selection and placement in the planting grid/pattern. Most of the varieties shall be eco-friendly i.e. generate lot of oxygen while helping reduce/absorb gases and dust;
- Entire plant will be aesthetically landscaped and as much as feasible natural gradient shall be maintained;
- Plantation outside the plant premises, in the near by villages shall be encouraged by supplying free saplings to the villagers.

4.2.2 Air Quality

❖ **Impact on Air Quality**

During construction phase, suspended particulate matter will be the main pollutant, which would be generated from the site development activities. However, the increase in ambient concentrations of air quality will be negligible. As most of the construction equipment will be mobile, the emissions are likely to be fugitive. The dust generated will also be fugitive in nature, which can be controlled by suitable mitigation measures like sprinkling of water and development of green cover.

The impacts will be localized in nature and the areas outside the proposed project boundary are not likely to have any major adverse impact with respect to ambient air quality.

❖ **Mitigation Measures**

No significant excavation of the area will be carried out except for the purpose of foundations for machineries. However, during dry weather conditions, it is necessary to control the dust generated by excavation and transportation activities. This will be achieved by regular water sprinkling.

Ambient air levels of SO₂ and NO_x are likewise expected to increase due to operation of construction machinery such as cranes, pay loaders, trucks etc. However, these levels are expected to be insignificant since these machines will be operated intermittently. More over most of the items are movable.

Hence, there will not be any concentration of emissions at any single point. It shall be ensured that both gasoline and diesel powered construction vehicles are properly maintained to minimize smoke in the exhaust emissions. Mitigative recommendations include the following:

- Sprinkling of water shall be done at frequent intervals by preferably using truck-mounted sprinklers;
- Sprinkling of water will be done along the roads and work zone areas to reduce the fugitive dust;



- Construction equipment shall be maintained and serviced regularly such that the gaseous emissions from these equipment are maintained within the design specifications;
- Since electrical power is available within project site, attempts shall be made to utilize the electrically powered machinery to the extent possible to minimize the emissions of SO₂ and NO_x during construction.
- Adopting good housekeeping practice will also help in control of fugitive emissions. Maintaining shop floor and roads in good condition minimizes the chances of fugitive emissions. Road Sweeping machine shall be used to clean roads;
- The trucks and other vehicles shall be maintained and serviced regularly to reduce air emissions; and
- Usage of respiratory protective equipment by all employees to be ensured.

The impact of fugitive dust emissions from the proposed units on air quality of the region is insignificant.

4.2.3 Water Resources and Quality

❖ **Impact on Water Resources and Quality**

During construction phase, water will be required only for construction of structures, sprinkling on road for dust suppression, domestic and non-domestic uses of the construction workers, that too only during daytime.

The wastewater generation during the construction period will be from the sanitary units provided for the workers. This wastewater will be treated in septic tanks and discharged into soak pits. Hence, there will not be any impact on the water regime due to discharge of sanitary treated wastewater.

❖ **Water Quality Mitigation Measures**

The earthwork, if required, will be avoided during rainy season and will be completed during summer season. Stone pitching on the slopes and construction of concrete drains for storm water to minimize soil erosion in the area will be undertaken. Also development of green belt in and around plant will be taken up during the monsoon season. In-plant roads will be paved.

4.2.4 Noise Environment

❖ **Impact due to Noise Levels**

The major sources of noise during the construction phase are vehicular traffic, operation of construction equipment like dozers, scrapers, concrete mixers, cranes, pumps, compressors, pneumatic tools, saws, vibrators etc. The operation of these equipments will generate noise ranging between 70-85 dB (A).

These noises will be generated within the plant boundary and will be transient in nature.



❖ **Noise Levels Mitigation**

Equipments will be maintained appropriately to keep the noise level within 85- dB (A). Wherever possible, equipment will be provided with silencers and mufflers. Construction activities will be restricted to day time only. Further, workers working in high noise areas will be provided with necessary protective devices e.g. ear plugs, ear-muffs etc.

4.2.5 Ecology

The proposed project site is already notified as an Industrial area. Therefore, no major loss of biomass is envisaged during construction phase.

A good green belt is available and even proposed within the project premises. As the land required for the proposed plant is industrial use, there may not be any significant impact on soil and agriculture in the general area. Trees will be planted under greenbelt development to compensate the vegetation loss during construction.

4.3 **Impacts during Operational Phase**

The proposed project involves production of 72 TPD of Linear Alkyl Benzene Sulphonic Acid (LABSA). For the purpose of impact assessment during the operational phase, the following components have been separately considered:

- Land use;
- Topography and climate;
- Air quality;
- Water resources and quality;
- Noise levels;
- Soil quality
- Solid waste management;
- Ecology
- Socio-Economics
- Economic Aspects
- Human Health
- Public Health and Safety

4.3.1 Land use

The impact on the land use during the operational phase of the project will not be distinct as there will be no major changes in the present land use of the site for establishment. Impact on land use will be insignificant.

No migration route of avi-fauna is observed or recorded. The development of greenbelt will help to attract avi-fauna. This will also have positive impact on the land use pattern.

4.3.2 Topography and Climate

The proposed site is fairly flat land. There will be no tall structures except stacks in the plant. The topography of the plant will not be changed significantly during the operational period. The exit temperature from the stacks will be maintained in the range of 30°C to 380°C, which is not likely to have any significant impact on the local or regional climate.



4.3.3 Air Quality

The sources of air pollution in the process due to the proposed plant facilities have been identified and quantified. The contribution from the nearby activities has been captured in the ambient air quality during baseline monitoring studies. Sulphur dioxide (SO₂) is the main pollutant in the sulphonation process. So the incremental ground level concentrations of SO₂ from the proposed process have been estimated by using dispersion modeling.

❖ **Details of Mathematical Modeling**

Prediction of impacts on air environment has been carried out by employing a mathematical model. In the present case, **Industrial Source Complex Short-Term (ISCST3)** dispersion model based on steady state gaussian plume dispersion, designed for multiple point sources for short term has been used for predicting the ground level concentrations. The computations deal with major pollutants like Sulphur dioxide, Particulate Matter and Nitrogen dioxide.

❖ **Model Options used for Computations**

The options used for short-term computations are:

- The plume rise is estimated by Briggs formulae, but the final rise is always limited to that of the mixing layer;
- Stack tip down wash is not considered;
- Buoyancy induced dispersion is used to describe the increasing plume dispersion during the ascension phase;
- Calms processing routine is used by default;
- Wind profile exponents are used by default, 'Irwin';
- Flat terrain is used for computations;
- It is assumed that the pollutants do not undergo any physico-chemical transformations and that there is no pollutant removal by dry deposition;
- Washout by rain is not considered; and
- Cartesian co-ordinate system has been used for computations.

❖ **Meteorological Input Data to the Model**

The hourly meteorological data recorded at site is converted to the mean hourly meteorological data as specified by CPCB and the same has been used in the mode. In absence of site specific mixing depths, mixing depths published in "Spatial Distribution of hourly Mixing Depths over Indian Region" by Mr.R.N.Gupta and recommended by CPCB have been used. The meteorological input data used for the model is presented in **Table-4.1.**



TABLE - 4.1
HOURLY MEAN METEOREOLOGICAL DATA

Sr. No.	Hour	Wind Direction (Degree)	Wind Speed (m/s)	Ambient Temperature (K)	Stability Class	Mixing Height
1	1:00	112.5	1.0	299.0	6	600
2	2:00	135	3.9	299.7	6	600
3	3:00	135	1.4	299.4	6	400
4	4:00	135	1.5	299.8	6	400
5	5:00	157.5	0.3	300.0	6	200
6	6:00	157.5	2.7	300.3	6	200
7	7:00	135	4.1	300.9	4	200
8	8:00	180	7.5	301.1	4	400
9	9:00	202.5	3.4	301.2	2	500
10	10:00	247.5	2.8	302.5	1	700
11	11:00	135	5.4	305.8	1	1000
12	12:00	135	8.7	306.6	1	1500
13	13:00	135	6.2	307.9	1	1500
14	14:00	135	3.6	308.6	1	2000
15	15:00	157.5	0.2	304.5	1	2000
16	16:00	225	5.4	303.4	2	2000
17	17:00	225	0.8	301.5	2	1500
18	18:00	225	3.0	301.4	2	1500
19	19:00	135	2.1	300.6	4	1500
20	20:00	135	6.3	300.4	4	1200
21	21:00	180	3.9	300.4	6	1000
22	22:00	247.5	7.2	296.4	6	800
23	23:00	247.5	3.4	295.5	6	600
24	24:00	135	1.1	294.6	6	600

❖ **Model Input Data**

The air pollution modeling carried out represents the worst case operating scenarios. The pollutants considered for modeling include Sulphur dioxide, Nitrogen dioxide and Particulate Matter.

The details of the stack and emissions envisaged from the proposed plant are given in **Table-4.2**.

TABLE - 4.2
DETAILS OF STACK EMISSIONS FROM THE PROPOSED PLANT

Parameters	Units	Stack-1	Stack-2
Stack attached to	---	Sulphonation Plant	DG Set (1000 KVA)
Stack Height	m	38.0	15.0
Stack diameter	m	0.45	0.15
Temperature	°C	30	380
Exit Gas velocity	m/s	7.75	19.0
Flow rate	Nm ³ /hr	5431	1209
Sulphur dioxide	g/s	5.28	0.01



❖ **Presentation of Results**

The simulations were done to evaluate SO₂ likely to be contributed by the proposed project. For the short term simulations, the concentrations were estimated around 1200 receptor points, chosen to obtain an optimum description of variations in concentrations over the site in 10-km radius covering 16 directions. The incremental concentrations are estimated for pre-monsoon season.

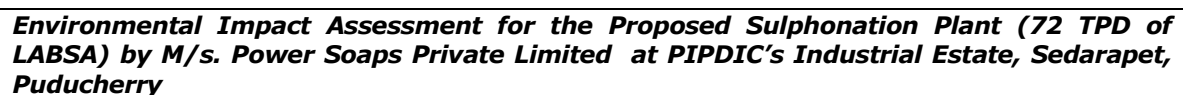
The predicted incremental Ground Level Concentrations (GLCs) for SO₂ likely to be contributed by the proposed sulphonation plant are presented in **Table-4.3**. The isopleths for SO₂ is presented in **Figure-4.1**.

TABLE-4.3
SHORT TERM MAXIMUM INCREMENTAL CONCENTRATIONS

Parameters	Concentration (µg/m ³)	Distance (km)	Direction
SO ₂	4.5	1.0	NW

❖ **Comments on Predicted Concentrations**

A perusal of **Table-4.3** reveals that the maximum incremental short term 24 hourly ground level concentrations for SO₂ likely to be encountered is 4.5 µg/m³ occurring at a distance of about 1.0 km in the NW direction.



Anticipated Environmental Impacts and Mitigation Measures

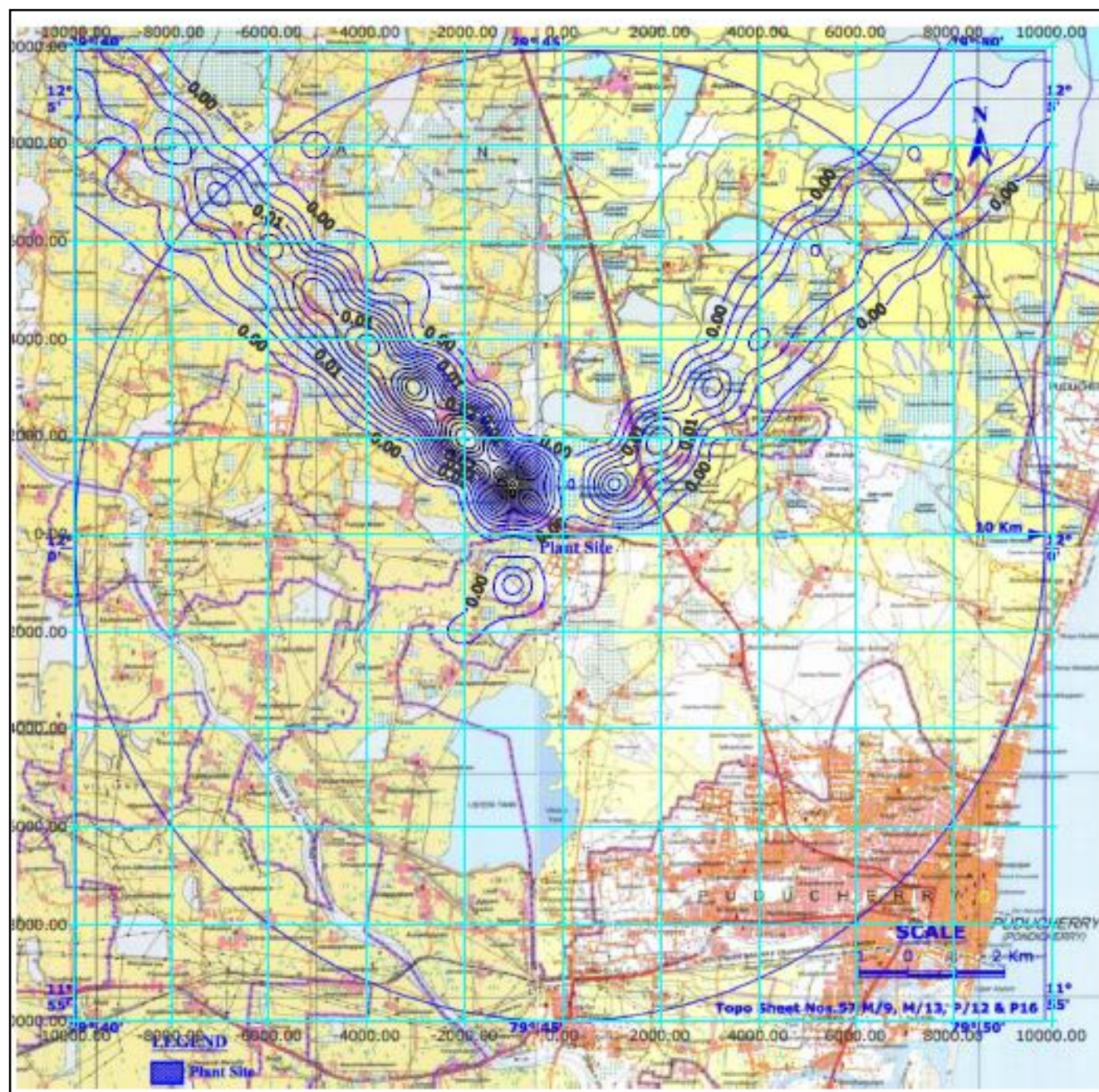


FIGURE - 4.1
SHORT TERM 24 HOURLY INCREMENTAL GLCS OF SO₂



❖ **Resultant Concentrations after Implementation of the Project**

The maximum incremental GLCs due to the proposed project for SO₂ is superimposed on the maximum baseline concentrations recorded during the study period to arrive at the likely resultant concentrations during the same period after implementation of the proposed project. The cumulative concentrations (baseline + incremental) after implementation of the project are tabulated below in **Table-4.4**.

TABLE-4.4
RESULTANT CONCENTRATIONS DUE TO INCREMENTAL GLC's

Pollutant	Baseline (µg/m ³)	Incremental (µg/m ³)	Concentration (µg/m ³)		
			Resultant	Distance/ Direction	NAAQ Limits - 2009 (Ind/Res)
SO ₂	14.1	4.5	18.6	1.0 km / NW	80

The predictions indicate that the SO₂ concentration is likely to be well within the prescribed limit for residential and rural zone even after the proposed plant comes into operation.

4.3.3.1 Air Pollution & Odour Control Management

The principal air pollution and odour control systems proposed for the sulphonation plant would be Electrostatic Precipitator (ESP) and Alkali Scrubber.

The SO₂, acid mist and other volatile gases coming from the sulfonation process will be cleaned by taking the gas through an ESP to remove the acid mist followed by alkali scrubber to remove the SO₂ gas contaminants. The clean gas will be discharged into atmosphere through a stack of 38.0 m height.

- **Effluent Gas Treatment System**

Effluent process gases leaving the sulfonation system or SO₃ absorber are virtually free of residual SO₃, but may contain unconverted SO₂ gas and entrained particulate anionic materials (acidic mists of sulfonic acid). However to remove the traces of SO₃, a filter vessel using candle filter element is installed, where fresh LAB is sprayed to absorb SO₃ gas and the gas system becomes virtually free of SO₃ gas.

To remove the acid mist particles which have escaped from acid mist eliminator, a vessel called ESP is installed. The recommended system employs a proprietary electrostatic precipitator designed to collect particulate mists. A packed tower scrubber is installed further to absorb SO₂ gas in a dilute caustic solution. Final effluent gases are suitable for discharge to the atmosphere. The flow sheet of effluent gas treatment system is shown in **Figure-4.2**.

- **Odour Control Measures**

Odour can be reduced by developing green belt. The Green belt is used to form a surface capable of sorbing and forming sinks for odorous gases. Leaves with their vast area in a tree crown, sorbs pollutants on their surface, thus effectively reducing their concentrations in the ambient air and source emissions. Plants which counteract odour are:



- ❖ Acacia farnesiana (Mexican plant): It is a type of bush with yellow coloured fragrant flowers. It does not have a rich canopy but it is very effective for counteracting smell.
- ❖ Melaleuca species: It has sweet fragrance and a thin canopy in India.
- ❖ Pine, Cedar, Junipers: They have excellent canopy and protection.
- ❖ Eucalyptus: It can be used as a very good green belt and can also be used as per odour source.

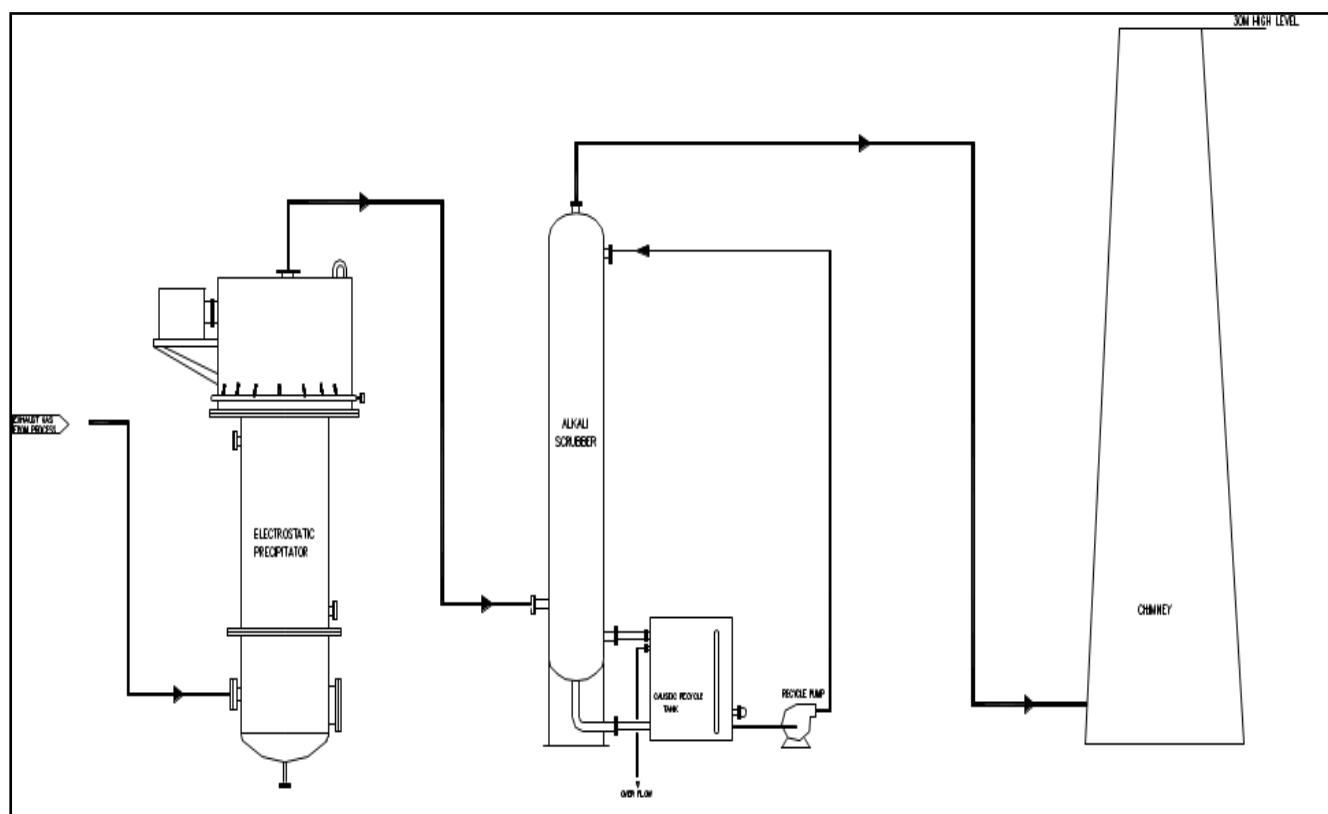


FIGURE- 4.2
FLOW SHEET OF EFFLUENT GAS TREATMENT SYSTEM

Air Pollution Control Measures:

- Highly improved ceramic packing will be used in towers for proper absorption;
- Improved cesium based mansanto catalyst which are highly active and kindle even at low temperatures with high conversion efficiency particularly used in 3rd and 4th pass completely to ensure 99.5% conversion and above;
- Avoiding sharp bends in design to avoid leakage, by usage of good quality materials in fabrication;
- Individual acid circulation pumps for all the three towers separately to ensure complete absorption and drying of air;
- Caustic lye water wash tower for washing the tail gases before it enters to chimney;
- Proper online SO₂ analyzer will be installed at the chimney outlet point;
- Providing ambient air monitoring station on corners of industry.



4.3.4 Impact on Water Resources and Water Quality

❖ **Impact on Water Resources**

The water balance and the waste water generation details are given in *Chapter-2*. The one time water requirement will be 48.5 KLD and the daily fresh water requirement will be 30.4 KLD. For industrial requirement 28.9 KLD of water will be sourced from the private supplier. For domestic requirement the quantity of 1.5 KLD will be sourced from PIPDIC. Therefore, the impact on the water resources will be insignificant.

❖ **Impact on water quality**

The wastewater generated from the processes and auxiliary facilities will be treated in Effluent Treatment Plant and sanitary wastewater will be treated in the septic tank followed by dispersion trench. The entire treated wastewater will be reused for industrial process and green belt development.

No wastewater will be discharged outside the plant premises. Hence, there will be no impact on the water regime due to the effluents from the proposed project.

4.3.4.1 *Water and Wastewater Management*

- *Water Conservation*

In order to conserve water resources and rainwater in the proposed project, efforts will be made to recharge ground water resources by constructing appropriate rainwater harvesting structures within the premises. The run-off from the roof terrace will be separately piped to underground collection tanks, after duly filtering the same. This water is proposed to be used as domestic water after necessary treatment. Hence, construction of rainwater harvesting pits will recharge the ground water, which is a positive impact due to the project. Storm water run-off from the entire plot will be collected through a network of drains constructed according to municipal regulations and the same will be discharged into external drainage system.

Periodic water audits will be conducted to explore the possibilities for minimization of water consumption. In order to reduce the water consumption in project, suitable measures will be taken. For watering the plants and landscaped areas and toilet flushing, treated sewage will be used, thus conserving fresh water.

- *Wastewater Treatment and Reuse*

The quantity of wastewater generation depends upon the quantity of water used for various purposes. The quantum of effluent generation from the various processes will be 14.3 KLD. The effluent generated will be treated in the proposed ETP and then reused for cooling tower make up (12.0 KLD) and greenbelt maintenance (2.3 KLD).

Wastewater generated from the domestic activities will be about 1.4 KLD and it will be treated in septic tank followed by dispersion trench. The condensate return of 6.1 KLD from the boiler after evaporation and steam loss will be recirculated for the demineralization plant, until there is any source of contamination or dissolved solids contained within the system. No wastewater shall be discharged outside the plant premises and the proposed project will be operated on zero discharge condition.



4.3.5 Impact on Noise Levels

The main noise generating sources are blowers, centrifugal pumps, compressors and stand by DG sets. The noise levels at the source for these units will be in the range of 80 – 90 dB (A).

The noise dispersion from the plant units has been computed based on the mathematical model as described below.

❖ **Mathematical Model for Sound Wave Propagation During Operation**

For an approximate estimation of dispersion of noise in the ambient air from the source point, a standard mathematical model for sound wave propagation is used. The sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence. Decrease in sound pressure level with distance from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

The details of the model are as follows:

- * Maximum number of sources is limited to 200;
- * Noise levels can be predicted at any distance specified from the source;
- * Model is designed to take topography or flat terrain;
- * Co-ordinates of the sources in meters;
- * Maximum and Minimum levels are calculated by the model;
- * Output of the model in the form of isopleths; and
- * Environmental attenuation factors and machine corrections have not been incorporated in the model but corrections are made for the measured L_{eq} levels.

The major noise generating sources from the proposed plant are listed in **Table- 4.5**. These are considered as input to the noise model.

TABLE - 4.5
NOISE LEVELS FROM THE PROPOSED EQUIPMENTS

Sr. No.	Sources	Expected Noise Levels in dB (A)
1.	Blowers	83.0
2.	Centrifugal pumps	81.0
3.	Compressors	85.0
4.	Stand by DG set	80.0
5.	Cooling Tower	80.0

➤ **Presentation of Results**

The model results are discussed below and are represented through contours in **Figure- 4.3**. The predicted model results at plant boundary are tabulated in **Table-4.6**.



TABLE - 4.6
PREDICTED NOISE LEVELS AT PLANT BOUNDARY

Sr. No.	Plant Boundary	Noise Level, dB(A)
1.	N	46.0
2.	NE	44.0
3.	E	38.2
4.	SE	47.5
5.	S	52.0
6.	SW	53.5
7.	W	51.3
8.	NW	50.5

The predicted noise levels at the boundary due to various plant activities will be ranging in between 30 to 54 dB (A). The increment noise levels are less than 40 dB (A) at all of the surrounding habitations. It is seen from the simulation results that the incremental noise levels at the residential zones do not contribute to violation of CPCB standards.

Impacts on the working personnel are not expected to be significant on account of the high level of automation of the plant, which means that the workers will be exposed for short duration only and that too intermittently.

The damage risk criteria as enforced by OSHA (Occupational Safety and Health Administration) to reduce hearing loss, stipulates that noise level upto 90 dB (A) are acceptable for 8 hour working shifts per day.

A perusal of **Table-4.5** clearly indicates that most of the equipment and machinery generates noise levels around 80.0 - 85.0 dB (A). Therefore adequate protective measures in the form of ear muffs/ear plugs will be provided to the workers working in high noise areas.

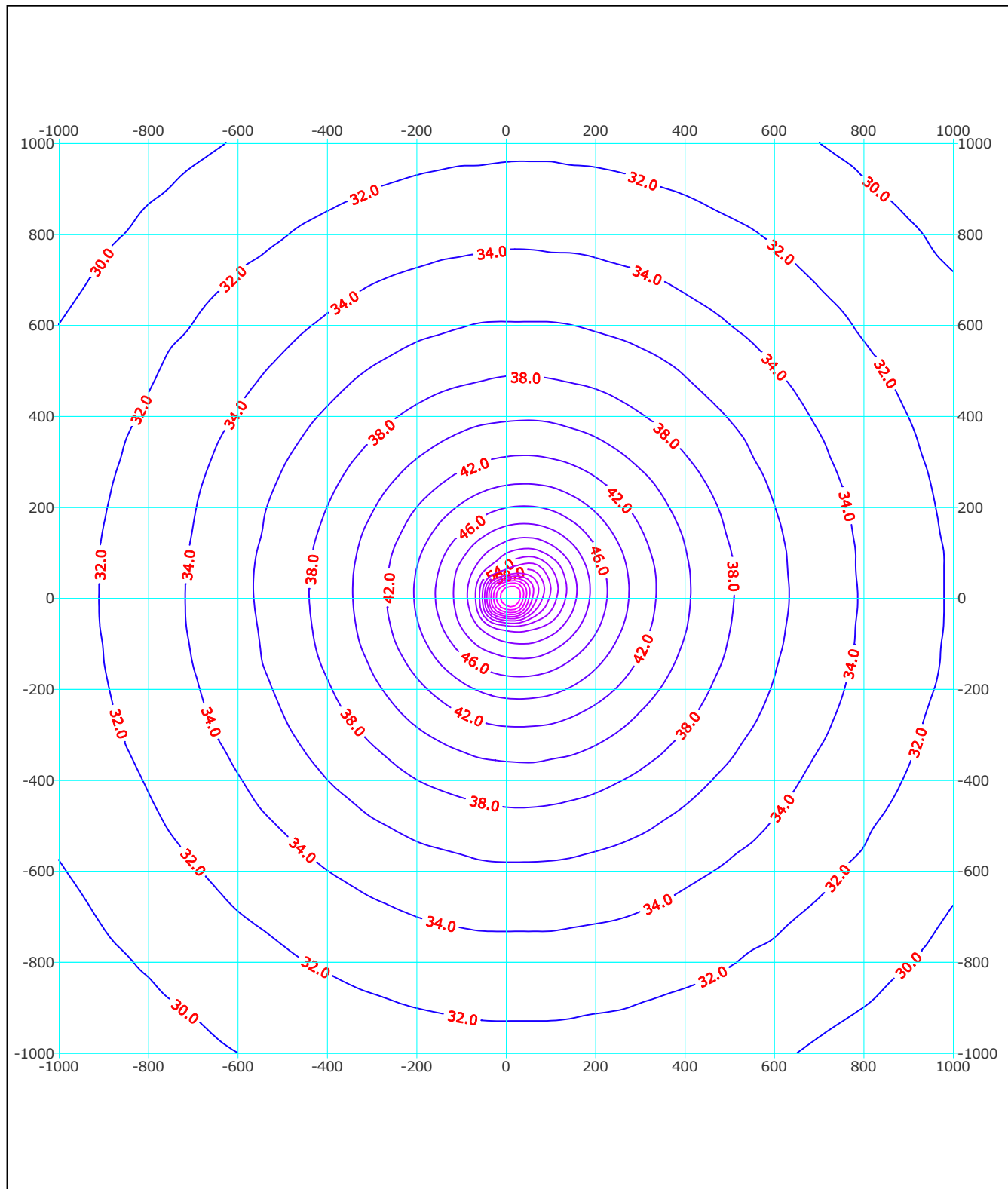


FIGURE - 4.3
PREDICTED NOISE DISPERSION CONTOURS



4.3.5.1 Noise Level Management

As per model results the incremental noise levels due to the proposed project will be <65 dB (A) at the plant boundaries in all the directions. The ambient noise levels in the region are within permissible limits and are envisaged to be within the permissible limits after commissioning of the proposed facilities also.

The noise level produced by any equipment will be controlled and will not exceed 85-dB (A) at a distance of 1.0-m from the plant boundary in any direction under any load condition.

Noise Attenuation Measures

- All the design/installation precautions as specified by the manufacturers with respect to noise control will be strictly adhered to;
- provision of acoustic enclosure for the equipment like DG set and suction side silencers;
- selection of low noise equipment like closed type compressor, isolation of noisy equipment from working personnel;
- Personnel working in noise generation areas will be provided with ear muffler;
- All rotary equipment like fans, blowers, pumps & compressors would be of low noise design;
- The work zone noise exposure of the operating personnel would be avoided by remote operation from the control rooms. The adequate noise control measures will be adopted and work zone noise levels will be controlled to be less than 85-dB (A).
- All the openings like covers and partitions shall be designed properly.

4.3.6 Impact on Soil Quality

Most of the impacts of proposed project on soils are restricted to the construction phase, which are expected to be stabilized during operational phase.

The impact on the topsoil will be confined to the main plant area. The air borne fugitive dust from the plant is likely to be deposited on the topsoil in the immediate vicinity of the plant boundary. Good green belt development has been envisaged to further arrest the fugitive emissions. Details of the green belt development plan proposed are described in *Chapter-9*.

4.3.7 Impact due to Solid Waste

The solid waste generated from the proposed sulphonation plant will be spent catalyst, sulphur ash and ETP sludge. The sulphur sludge (0.003 TPD) generated will be deposited in sulphur melter process. The spent catalyst (0.3 TPA) will be generated during the turnaround time of the plant i.e., when the plant is shutdown for annual maintenance jobs. For every shut down about 300-kgs/annum of spent catalyst will be generated.

Solid Waste Management

- As per Schedule IV of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, the spent is hazardous and therefore the spent catalyst



removed during annual shut-down will be collected in HDPE Bags, packed in drums and will be sent to the supplier for recycling.

- The sulphur ash (0.7 TPA) and sulphur sludge (0.003 TPD) will be collected in HDPE Bags, stored in hazardous waste storage room and it will be disposed in the secured land fill facility located at Gummidipoondi.
- The scrubber residue (4.5 TPA) generated will be concentrated and reused in detergent industry.

4.3.8 Impact on Ecology

Impacts on Terrestrial Ecology

The impact on terrestrial ecology may occur due to emission of gaseous pollutants like SO₂, SPM and NO_x. The main sources of air pollution from the proposed project would be the stack attached to sulphonation plant and the main pollutant is Sulphur dioxide only. The impact of air pollutants on vegetation due to the proposed project is identified and quantified by using air dispersion modeling.

The incremental concentrations predicted from the modeling simulations are well within the permissible NAAQ limits. Hence, no impact is envisaged on the surrounding terrestrial ecology.

❖ Impact on Aquatic Ecology

Since the unit will be operating on zero discharge process and no perennial nallahs or streams are present in the study area, no adverse impact on aquatic ecology is envisaged.

❖ Impact on Migratory Paths for Wild life

As per the Forest Working Plans, there are no identified migratory paths for major and minor wild life in the project site and the study area. The identified avi-fauna, which are observed in the project site and in the study area, are local migrants only. Therefore, the proposed plant operations are not likely to have any adverse impact on the paths for avi-fauna.

4.3.9 Impact on Socio-Economics

It is obvious to assume that the activities of the proposed production will produce some improvements in the socio-economic levels in the study area. The anticipated impact of this project on various aspects is described in the following sections.

4.3.9.1 Impact on Human Settlement

The proposed project will be carried out in a notified industrial area (PIPDIC). Hence no impact on external human settlements is envisaged.

4.3.9.2 Impact on Population Growth

This project will not have any major impact on the population growth, as the manpower requirement for the proposed project is not a major concern. Hence increase in the population and related strain on infrastructure of the study area is not envisaged.



4.3.9.3 Impact on Literacy and Educational Facilities

Better literacy rates are possible due to assumed better economic conditions of the people. Better literacy means better social status and thereby improved life style. This will be a positive impact due to the proposed project.

4.3.10 Impact on Economic Aspects

The impact of industrialization on the economic aspects can be clearly observed. The proposed activities will provide indirect employment to persons of different skills. The local population is the largest beneficiary among the employees. It will improve the economic conditions of certain families indirectly who are involved in business and service oriented activities.

4.3.11 Impacts on Human Health

The impact from the air emissions of SO₂ is not expected to be significant since the stack design and the atmospheric conditions are such that the ambient air quality at present as well as in future after the implementation of the project will be well within the prescribed ambient air quality limits set forth by CPCB.

The proponent of this facility is adopting effective control systems at all the identified sources of dust generation.

4.3.12 Impacts on Public Health and Safety

The discharge of waste materials (stack emission, wastewater and solid wastes) from process operations can have potential impact on public safety and health. The impact from the discharge of waste products is not expected to be significant since, the adverse impacts on ambient air, water and soil quality are predicted to be low.

It is predicted that the impacts on public safety will be very low, due to the effective safety system and safety management available in the plant. Overall, the impact on public safety and health from the sulphonation plant activities are likely to be insignificant.

CHAPTER-5

ANALYSIS OF ALTERNATIVES



5.0 ANALYSIS OF ALTERNATIVES

In this chapter the alternate site as well as technology for the proposed sulphonation plant is considered.

5.1 Process and Technology Selection

The air/SO₃ process has rapidly overtaken the Oleum process as the predominate choice for Sulphonation in countries like United States, Europe, Nigeria, Indonesia, Malaysia, Brazil etc. The proposed technology has the following features:

- The air/SO₃ process is capable of sulphonating a wide variety of feedstocks and producing excellent quality products from them.
- The air/SO₃ process is a large scale continuous process suitable for 24/7 manufacturing.
- For large scale production, the air/SO₃ process clearly has an advantage in terms of reagent cost where it has the lowest cost per kg of SO₃ reacted when compared to other processes.
- Finally the cost of waste disposal for the air/SO₃ sulphonation process is minimal when compared to chlorosulphuric acid and oleum sulfonation procedures as the waste disposal cost for the spent sulfuric acid has a major impact on the profitability of these processes.

The Multiple Tube Falling film (MTF) Reactor technology that is proposed to be adopted in PSPL, is a well established and frequently preferred reactor principle for Sulphonation.

SO₃ in the gaseous form is a very aggressive reactant and the reactions are all extremely rapid and exothermic. At such intense conditions, the MTF Reactor helps to achieve a better control for the molar ratio of the reactants which is highly essential for obtaining products of high quality.

5.2 Site Selection

The proposed sulphonation plant will be developed in PIPDIC industrial estate which is notified as Special Economic Zone. Further, adequate land is available with PSPL. Hence, no alternative sites have been examined.

CHAPTER-6

ENVIRONMENTAL MONITORING PROGRAM



6.0 ENVIRONMENTAL MONITORING PROGRAM

6.1 Implementation Schedule of EMP

The mitigation measures suggested in *Chapter-4* will be implemented so as to reduce the impact on environment due to the operations of the proposed project. In order to facilitate easy implementation, mitigation measures are phased as per the priority implementation. The priority of the implementation schedule is given in **Table-6.1**.

**TABLE - 6.1
EMP IMPLEMENTATION SCHEDULE**

Sr. No.	Recommendations	Requirement
1	Air pollution control measures	Before commissioning of the proposed activity
2	Water pollution control measures	Before commissioning of the proposed activity
3	Noise control measures	Along with the commissioning of the proposed activity
4	Solid waste management	During commissioning of the proposed activity
5	Green belt development	Stage-wise implementation

This chapter presents the details of environmental monitoring schedule during construction and operational phase of the proposed project.

6.2 Environmental Monitoring

The environmental monitoring is important in terms of evaluating the performance of pollution control equipments installed in the project. The sampling and analysis of the environmental attributes will be as per the guidelines of Puducherry Pollution Control Committee (PPCC) / Central Pollution Control Board. The frequency of sampling and location of sampling will be as per the directives of PPCC.

Environmental monitoring will be conducted on regular basis by Power Soaps Private Limited to assess the pollution level in the surrounding area. Usually, as in the case of the study, an impact assessment study is carried over short period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, regular monitoring programme of the environmental parameters is essential to take into account the changes in the environment.

The objective of environmental monitoring is:

- To verify the result of the impact assessment study in particular with regard to new developments;
- To follow the trend of parameters which have been identified as critical;
- To check or assess the efficacy of the controlling measures;
- To ensure that new parameters, other than those identified in the impact assessment study, do not become critical through the commissioning of the proposed plant;
- To check assumptions made with regard to the development and to detect deviations in order to initiate necessary control measures; and



- To establish a database for future Impact Assessment Studies for similar new projects.

The attributes, which require regular monitoring, are specified underneath:

- 1] Air quality;
- 2] Water and wastewater quality;
- 3] Noise levels;
- 4] Soil quality;
- 5] Ecological preservation and afforestation; and
- 6] Socio Economic aspects and community development

Monitoring and Reporting Procedure

Regular monitoring of important and crucial environmental parameters is of immense importance to assess the status of environment during operational phase. With the knowledge of baseline conditions, the monitoring program can serve as an indicator for any deterioration in environmental conditions due to operational phase and suitable mitigatory steps could be taken in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring. The following routine monitoring program will be implemented under the post project monitoring:

➤ **Air Pollution and Meteorological Aspects**

Both ambient air quality and stack emissions will be monitored. The ambient air quality will be monitored once in three months in the work zone, at the DG set location and surroundings through a reputed environmental laboratory recognized by CPCB/MoEF & CC. Similarly, the stack monitoring will be carried out once in three months and the results will be reported to pollution control authorities.

➤ **Wastewater Quality**

The domestic sewage and effluent emanating from the project will be monitored once in a month for physico-chemical characteristics.

➤ **Noise Levels**

Noise levels in the work zone environment such as process blower, air compressors, centrifugal pumps and DG set is to be monitored. Similarly ambient noise levels shall be monitored in and around project premises.

6.3 Monitoring Schedule

A monitoring schedule is very important in order to ensure that effluent and emissions conform to the standard for which control measures have been designed. As it is required that installation and operation of water pollution control facilities should limit concentration and quantum of pollutants released to the environment, proper regular continuous monitoring of flow and pollutants should be done.

6.3.1 Environmental Monitoring during Construction Phase

The environmental monitoring cell of the construction team will be coordinating all the monitoring programs during the construction phase. The proposed monitoring schedule during the construction phase of the project is outlined in **Table-6.2**.



**TABLE-6.2
ENVIRONMENTAL MONITORING SCHEDULE DURING CONSTRUCTION PHASE**

Sr. No.	Monitoring Location	Monitoring Frequency	Duration of Sampling	Important Monitoring Parameters
A	Project Activity : Earth work, land development and factory building construction			
I	Ambient Air Quality Monitoring			
	Two locations at proposed project site (to monitor impacts of proposed construction activities)	Once in a month	8 hrs	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ and CO
II	Ambient Noise Level			
	Four locations at proposed project site (to monitor impacts of proposed construction activities)	Once in a month	Hourly for 24 hrs	Sound Pressure Levels, L _{eq} , L _{max}
III	Solid Waste Disposal Mechanism			
	Project site (Disposal site of construction debris and cutting material)	Daily	Twice a day	Physical Observation
IV	Traffic Monitoring			
	Near Project Site (to monitor impacts of temporary construction traffic)	Daily	Hourly	Vehicle count and type
V	Occupational Health and Safety	Twice in a week	Continuous database management of casualties	General Health aspects

6.3.2 Environmental Monitoring during Operation Phase

The Environment Engineer, with the assistance of chemist, will be co-ordinating the Environmental monitoring during operation phase. A comprehensive monitoring program is suggested in **Table-6.3**.

**TABLE-6.3
ENVIRONMENTAL MONITORING SCHEDULE DURING OPERATION PHASE**

Sr. No.	Particulars	Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
I	Air Pollution & Meteorology			
A	Stack Monitoring			
1	Sulphonation plant	Once in a month	Iso-Kinetic, manual procedure	PM, SO ₂ , NO ₂
B	Air Quality Monitoring			
1	Three locations in and around the plant	Once in a month	24 hr continuously	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂
2	Work zone monitoring	Once in 3 months	Low volume sampler	SO ₂ & SO ₃
C	Meteorology			
	Wind speed, direction, temperature, relative humidity, atmospheric pressure, rainfall etc shall be monitored at plant site			

Sr. No.	Particulars		Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
II	Water and Wastewater Quality				
	A	Water Quality			
	1	Ground Water Wells in and around plant area	Once in a year	Grab	Parameters as per IS : 10500- 2012
	B	Process Wastewater			
	1	Treated Effluent from ETP	Once in a month	24 hr composite	As per EPA Rules, 1986
III	Industrial Noise Levels				
	Near all machineries		Once in a month	8 hr continuous with 1 hr interval	Noise levels in dB (A)
IV	Ambient Noise Levels				
	On the Plant Boundary at all directions		Once in 3 months	24 hr continuous with one hr interval	Noise levels in dB (A)
V	Soil Quality				
	In and around the plant at four locations		Once in a year	Grab	Physio-chemical and metals

The monitoring schedule of the pollution control system of sulphonation plant should cover the following:

➤ **Meteorology**

Automatic weather monitoring station shall be provided to monitor wind speed, wind direction, temperature, relative humidity, atmospheric pressure and rainfall. The parameters are recorded at one-hour frequency. The same data will be used for the improvement of environment.

➤ **Ambient Air Quality**

- The standards already prescribed by the Central Pollution Control Board for industrial area are applicable inside the plant boundary area;
- The ambient air quality shall be monitored once in a month at least three locations around the plant to monitor PM₁₀, PM_{2.5}, SO₂ and NO₂; and
- The fugitive emission in and around the individual unit/shop should also be measured for SO₂ & SO₃ regularly.

➤ **Stack Emissions**

- Stack emissions monitoring shall be carried out regularly at all stacks for particulate matter, SO₂, SO₃ and NO₂ for compliance of emission standards from respective plant/shop and to generate data. In addition, flow rate, temperature, velocity shall also be monitored for better interpretation of the results.
- The program of stack monitoring should be prepared in such a way that the concerned appropriate parameters are monitored in rotation at least once in each stack at the interval of one month.



➤ **Fugitive Emissions**

- Fugitive emissions of Sulphurdioxide (SO_2) will be monitored at material handling area, process area and other areas as specified by PPCC. The monitoring will be done preferably on 8-hour basis with low volume sampler. However, depending upon the prevalent conditions at the site, the period of measurement can be varied.

➤ **Wastewater Quality**

- a. Source of wastewater generation; and
- b. Wastewater treatment facilities

Source monitoring would help in water conservation, preventing the loss of chemicals and other materials and also in efficient operation of the manufacturing units. Unit wise monitoring at treatment plant would help in keeping a check over the operation of treatment unit and to take measures to correct malfunctioning of the units.

The main parameters for the effluent monitoring are pH, Oil & Grease, Total Dissolved Solids, Total Suspended Solids, Total Hardness, Chlorides, Sulphates, Heavy metals, BOD and COD.

➤ **Water Quality**

The wells in the surrounding villages shall be identified based on the ground level contours, ground water flow etc., and water quality shall be monitored on annual basis.

➤ **Noise Levels**

Noise levels in the work zone environment such as process ID (Induced Draft) fan and air compressors, shall be monitored. The frequency shall be once in three months in the work zone. Similarly, ambient noise levels at 5 locations shall be monitored on a seasonal basis.

➤ **Soil Quality**

Soil quality shall be monitored at four locations. The parameters shall include physico-chemical parameters and heavy metals.

CHAPTER-7

ADDITIONAL STUDIES



7.0 ADDITIONAL STUDIES

This chapter describes the additional studies like risk assessment & disaster management plan, Socio-economic development activities and public consultation.

7.1 Risk Assessment and Disaster Management Plan

Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that exist in the proposed project. On the other hand, risk analysis deals with the identification and quantification of risks, the plant equipment and personnel are exposed to, due to accidents resulting from the hazards present in the plant.

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of populations etc. Much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies.

In the sections below, the identification of various hazards, probable risks in the sulphonation unit, maximum credible accident analysis, consequence analysis are addressed which gives a broad identification of risks involved in the proposed project. Based on the risk estimation for fuel and chemical storage, Disaster Management Plan (DMP) has also been presented.

7.2 Approach to the Study

Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. The risk assessment study covers the following:

- Identification of potential hazard areas;
- Identification of representative failure cases;
- Visualization of the resulting scenarios in terms of fire (thermal radiation) and explosion;
- Assessment of the overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios;
- Assessment of the overall suitability of the site from hazard minimization and disaster mitigation point of view;
- Furnishing specific recommendations on the minimization of the worst accident possibilities; and
- Preparation of broad DMP, On-site and Off-site Emergency Plan, which includes occupational Health and Safety Plan.

7.3 Hazard Identification

Identification and quantification of hazards in the sulphonation plant is of primary significance in the risk analysis. Hence, all the components of a system / plant / process have been thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The following two methods for hazard identification have been employed in the study:

- Identification of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of Government of India (GOI Rules, 1989); as amended in 2000; and
- Identification of hazardous units and segments of plants and storage units based on relative ranking technique, viz. Fire-Explosion and Toxicity Index (FE&TI).



Hazardous substances may be classified into three main classes: Flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345-M. The storage of the hazardous substance in the proposed project is given in **Table-7.1**.

**TABLE - 7.1
CATEGORY-WISE SCHEDULE OF STORAGE TANKS**

Sr. No	Product	No of Tanks	Classification	Design Capacity
1	HSD	1	B	250 Litres

A: Dangerous Petroleum B: Non- Dangerous Petroleum C: Heavy Petroleum

Hazardous characteristics of the major flammable materials employed in the proposed project are listed in **Table-7.2**.

**TABLE - 7.2
PROPERTIES OF STORAGE FUELS**

Chemical	Codes/Label	TLV	FBP	MP	FP	UEL	LEL
			°C			%	
HSD	Flammable liquid	5 mg/m ³	400	338	32-96	7.5	0.6

TLV : Threshold Limit Value FBP : Final Boiling Point
MP : Melting Point FP : Flash Point
UEL : Upper Explosive Limit LEL : Lower Explosive Limit

7.3.1 Identification of Major Hazard Installations Based on GOI Rules, 1989

Following the accidents in the chemical industry in India over a few decades, a specific legislation covering major hazard activities has been enforced by Govt. of India in 1989 in conjunction with Environment Protection Act, 1986. This is referred here as GOI rules 1989. For the purpose of identifying major hazard installations the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals.

A systematic analysis of the fuels/chemicals and their quantities of storage has been carried out, to determine threshold quantities as notified by GOI Rules, 1989 and the applicable rules are identified. Applicability of storage rules is summarized in **Table-7.3**.

**TABLE-7.3
APPLICABILITY OF GOI RULES TO FUEL STORAGE**

Sr. No.	Chemical/ Fuel	Listed in Schedule	Total Quantity (Litres)	Threshold Quantity (T) for Application of Rules	
				5,7-9,13-15	10-12
1	HSD	3 (1)	250	25 MT	200 MT

7.4 Hazard Assessment and Evaluation

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities, and safeguards.



7.4.1 Preliminary Hazard Analysis (PHA)

A preliminary hazard analysis is carried out initially to identify the major hazards associated with storages and the processes of the plant. This is followed by consequence analysis to quantify these hazards. The various process activities involved in the unit are purely chemical operations, those are not complex or hazardous. Hence, no major hazards with potential for any emergency situation exist in the process plant.

The preliminary hazards related to the Plant and storage areas are given below in **Table-7.4**

TABLE - 7.4
PRELIMINARY HAZARD ANALYSIS FOR PROCESS AND STORAGE AREAS

Equipment	Process	Potential Hazard	Provision
Generator	Converts mechanical energy into electrical energy.	Mechanical hazards and fire hazards in 1. Lube oil system 2. Cable galleries 3. Short circuits	As above
Power Transformers	-	Fire and explosion	All electrical fittings and cables are provided as per the specified standards.
Switch Yard control room	-	Fire in cable galleries and switch	As above
HSD Storage	Used as start-up fuel for DG sets, and also will be used for vehicular transportation	Fire & explosion	Leaks detection system will be provided.

7.4.2 Fire Explosion and Toxicity Index (FE&TI) Approach

Fire, Explosion and Toxicity Indexing (FE & TI) is a rapid ranking method for identifying the degree of hazard. The application of FE & TI would help to make a quick assessment of the nature and quantification of the hazard in these areas. However, this does not provide precise information.

The degree of hazard potential is identified based on the numerical value of F&EI as per the criteria given below:

F & EI Range	Degree of Hazard
0-60	Light
61-96	Moderate
97-127	Intermediate
128-158	Heavy
159-up	Severe

By comparing the indices F & EI and TI, the unit in question is classified into one of the following three categories established for the purpose (**Table-7.5**).



**TABLE-7.5
FIRE EXPLOSION AND TOXICITY INDEX**

Category	Fire and Explosion Index (F&EI)	Toxicity Index (TI)
I	F&EI < 65	TI < 6
II	65 < or = F&EI < 95	6 < or = TI < 10
III	F&EI > or = 95	TI > or = 10

Certain basic minimum preventive and protective measures are recommended for the three hazard categories.

7.4.2.1 Results of FE and TI for Storage/Process Units

Fire and Explosion are the likely hazards, which may occur due to the fuel and chemical storage. Hence, Fire and Explosion index has been calculated for implant storage of HSD. Detailed estimates of FE&TI are given in **Table-7.6**.

**TABLE-7.6
FIRE EXPLOSION AND TOXICITY INDEX FOR STORAGE FACILITIES**

Chemical	Quantity	F & EI	Category	TI	Category
HSD	250 Litres	0.9	Light	-	-

7.4.3 Conclusion

Results of FE&TI analysis show that the storage of HSD falls in light category of fire and explosion index with a nil toxicity index.

7.4.4 Maximum Credible Accident Analysis (MCAA)

Hazardous substances may be released as a result of failures or catastrophes, causing possible damage to the surrounding area. This section deals with the question of how the consequences of the release of such substances and the damage to the surrounding area can be determined by means of models. Major hazards posed by flammable storage can be identified taking recourse to MCA analysis. MCA analysis encompasses certain techniques to identify the hazards and calculate the consequent effects in terms of damage distances of heat radiation, toxic releases, vapour cloud explosion, etc.

A host of probable or potential accidents of the major units in the complex arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. Preliminary hazard analysis for whole plant is given in **Table-7.7**.



**TABLE - 7.7
PRELIMINARY HAZARD ANALYSIS FOR THE WHOLE PLANT IN GENERAL**

PHA Category	Description of Plausible Hazard	Recommendation	Provision
Environ-mental factors	If there is any leakage and eventuality of source of ignition.	---	All electrical fittings and cables are provided as per the specified standards. All motor starters are flame proof.
	Highly inflammable nature of the chemicals may cause fire hazard in the storage facility.	A well designed fire protection including protein foam, dry powder, CO ₂ extinguisher should be provided.	Fire extinguisher of small size and big size are provided at all potential fire hazard places. In addition to the above, fire hydrant network is also provided.

The reason and purpose of consequence analysis are manifold like:

- Part of Risk Assessment;
- Plant Layout/Code Requirements;
- Protection of other plants;
- Protection of the public;
- Emergency Planning; and
- Design Criteria.

The results of consequence analysis are useful for getting information about all known and unknown effects that are of importance when some failure scenario occurs in the plant and also to get information as how to deal with the possible catastrophic events. It also gives the workers in the plant and people living in the vicinity of the area, an understanding of their personal situation.

7.4.4.1 Damage Criteria

The fuel storage and unloading at the storage facility may lead to fire and explosion hazards. The damage criteria due to accidental release of any hydrocarbon arise from fire and explosion. The vapours of these fuels are not toxic and hence no effects of toxicity are expected.

Tank fire would occur if the radiation intensity is high on the peripheral surface of the tank leading to increase in internal tank pressure. Pool fire would occur when fuel collected in the dyke due to leakage gets ignited.

- **Fire Damage**

A flammable liquid in a pool will burn with a large turbulent diffusion flame. This releases heat based on the heat of combustion and the burning rate of the liquid. A part of the heat is radiated while the rest is convected away by rising hot air and combustion products. The radiations can heat the contents of a nearby storage or process unit to above its ignition temperature and thus result in a spread of fire. The radiations can also cause severe burns or fatalities of workers or fire fighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of a flammable liquid pool likely to be created due to leakage or catastrophic failure of a storage or process vessel. This will help to decide the location of other storage/process vessels, decide the type of protective clothing the workers/fire fighters' need, the duration of time for which they can be in the zone, the fire extinguishing measures needed and the protection methods needed for the nearby storage/process vessels. **Tables-7.8** tabulates the damage effect on equipment and people due to thermal radiation intensity.



**TABLE-7.8
DAMAGE DUE TO INCIDENT RADIATION INTENSITIES**

Sr. No.	Incident Radiation (kW/m ²)	Type of Damage Intensity	
		Damage to Equipment	Damage to People
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without a flame	50% Lethality in 1 min. Significant injury in 10 sec.
3	19.0	Maximum thermal radiation intensity allowed on thermally unprotected adjoining equipment	--
4	12.5	Minimum energy to ignite with a flame; melts plastic tubing	1% lethality in 1 min.
5	4.5	--	Causes pain if duration is longer than 20 sec, however blistering is un-likely (First degree burns)
6	1.6	--	Causes no discomfort on long exposures

The effect of incident radiation intensity and exposure time on lethality is given in **Table- 7.9**.

**TABLE-7.9
RADIATION EXPOSURE AND LETHALITY**

Radiation Intensity (kW/m ²)	Exposure Time (seconds)	Lethality (%)	Degree of Burns
1.6	--	0	No Discomfort even after long exposure
4.5	20	0	1 st
4.5	50	0	1 st
8.0	20	0	1 st
8.0	50	<1	3 rd
8.0	60	<1	3 rd
12.0	20	<1	2 nd
12.0	50	8	3 rd
12.5	--	1	--
25.0	--	50	--
37.5	--	100	--

7.5 Visualization of MCA Scenarios

7.5.1 Scenarios considered for MCA Analysis

7.5.1.1 Fuel Storage

HSD is the fuel used in the plant. HSD is used for DG set operation during the power failure from state grid and transportation of vehicles. The HSD is stored underground in an isolated place. In case of fuel released in the area catching fire, a steady state fire will ensue. Failures in pipeline may occur due to corrosion and mechanical defect. Failure of pipeline due to external interference is not considered as this area is licensed area and all the work within this area is closely supervised with trained personnel.



7.5.1.2 Modeling Scenarios

Based on the consumption of fuels and chemicals the following failure scenarios for the sulphonation unit have been identified for MCA analysis and the scenarios are discussed in **Tables-7.10**.

TABLE-7.10
SCENARIOS CONSIDERED FOR MCA ANALYSIS

Sr. No.	Fuel/Chemical	Quantity	Scenario
1	Failure of HSD tank	250 Litres	Pool Fire

7.5.2 Details of Models Used for MCA Analysis

Heat Radiation program '**RADN**' has been used to estimate the steady state radiation effect from various storage of fuel and chemicals at different distances. The model has been developed by *M/s VIMTA Labs Limited, Hyderabad* based on the equations compiled from various literatures by Prof.J.P.Gupta, Department of Chemical Engineering, IIT Kanpur.

- **Properties of Fuels Considered For Modeling Scenarios**

The chemical data for various fuels used for modeling is tabulated in **Table-7.11** and is compiled from various literatures.

TABLE-7.11
PROPERTIES OF FUELS CONSIDERED FOR MODELING

Sr. No.	Fuel	Molecular Weight Kg/kg. mol	Boiling Point °F	Density Kg/m ³
1	HSD	114.24	369.0	840

- **Pool Fire Due to Failure of HSD Storage tank**

The maximum quantity of storage of HSD will be 250 Litres. The most credible failure is the rupture of the largest pipe connecting the storage tank. As the worst case, it is assumed that the entire contents leak out into the dyke forming a pool, which may catch fire on finding a source of ignition.

7.5.2.1 Results and Discussion - Pool Fire

The results of MCA analysis are tabulated indicating the distances for various damages identified by the damage criteria. Calculations are done for radiation intensities levels of 37.5, 25, 19, 12.5, 4.5 and 1.6-kW/m², which are presented in **Table-7.12** for different scenarios. The distances computed for various scenarios are given in meters and are from the edge of the pool fire. The radiation intensities are computed for the maximum and minimum diameter of the storage tanks.

A perusal of the below table clearly indicates that 37.5 kW/m² (100% lethality) occurs within the radius of the pool which is computed at 5.6 m in case of HSD tank on pool fire. This vulnerable zone will damage fuel storage equipment falling within the pool radius.



Similarly, the threshold limit for first degree burns is 4.5 kW/m^2 , this vulnerable zone in which the thermal fluxes above the threshold limit for first degree is restricted to 18.8 m in case of HSD tank on pool fire.

**TABLE-7.12
OCCURRENCE OF VARIOUS RADIATION INTENSITIES- POOL FIRE**

Radiation and Effect	Capacity	Radiation Intensities (kW/m^2) / Distances (m)				
		37.5	25.0	19.0	12.5	4.5
HSD	250 Litres	5.6	7.1	8.3	10.5	18.8

7.6 Disaster Management Plan

The Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training should be provided through rehearsals/drills.

To tackle the consequences of a major emergency inside the factory or immediate vicinity of the factory, a Disaster Management Plan has to be formulated and this planned emergency document is called "Disaster Management Plan".

The objective of the Industrial Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of affected area;
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency.

In effect, it is to optimize operational efficiency to rescue, rehabilitate and render medical help and to restore normalcy.

7.6.1 Specific Emergencies Anticipated

Fire consequences can be disastrous, since they involve huge quantities of fuel either stored or in dynamic inventory in pipelines or in nearby areas. Toxic releases can affect persons working around. Preliminary hazard Analysis has provided a basis for consequence estimation.

7.6.2 Emergency Organization

It is recommended to set up an Emergency Organization. A senior executive who has control over the affairs of the plant would be heading the Emergency Organization. He would be designated as Site Controller. Works Manager would be designated as the Incident Controller. In the case of stores, utilities, open areas, which are not under the control of the Production



Heads, Senior Executive responsible for maintenance of utilities would be designated as Incident Controller. All the Incident Controllers would be reporting to the Site Controller.

Each Incident Controller, for him self, organizes a team responsible for controlling the incidence with the personnel under his control. Shift In-charge would be the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller. Emergency co-ordinators would be appointed who would undertake the responsibilities like fire fighting, rescue, rehabilitation, transport and provide essential and support services. For this purposes, Security In-charge, Personnel Department, Essential services personnel would be engaged. All these personnel would be designated as Key personnel.

In each shift, electrical supervisor, electricians and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of staff members in the office/plant offices would be drafted and their services would be utilized as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

7.6.2.1 Emergency Communication

Whoever notices an emergency situation such as fire, escalation of fire, leakage etc will inform his immediate superior and Emergency Control Center. A place nearer to the security office shall be identified as Emergency Control Center. The person on duty in the Emergency Control Center would appraise the Site Controller. Site Controller verifies the situation from the Incident Controller of that area or the Shift In-charge and takes a decision about an impending On Site Emergency. This would be communicated to all the Incident Controllers, Emergency Co-ordinators. Simultaneously, the emergency warning system would be activated on the instructions of the Site Controller.

7.6.3 Onsite Emergency Preparedness and Response for Accidents

7.6.3.1 Emergency Responsibilities

The responsibilities of the key personnel are appended below:

Site Controller:

On receiving information about emergency he would rush to Emergency Control Center (ECC) and take charge of ECC and the situation and;

- Assesses the magnitude of the situation on the advice of incident Controller and decides, Whether the affected area needs to be evacuated,
- Whether personnel who are at assembly points need to be evacuated,
- Declare Emergency and order for operation of emergency siren,
- Organizes announcement by public address system about location of emergency,
- Assesses which areas are likely to be affected, or need to be evacuated or need to be alerted,
- Maintains a continuous review of possible development and assesses the situation in consultation with Incident Controller and other Key Personnel as to whether shutting down the plant or any section of the plant is required and if evacuation of persons is required,
- Directs personnel for rescue, rehabilitation, transport, fire, brigade, medical and other designated mutual support systems locally available, for meeting emergencies.



- Controls evacuation of affected areas, if the situation is likely to go out of control or effects are likely to go beyond the premises of the factory, informs the District Emergency Authority, Police, Hospital and seeks their intervention and help,
- Informs the Inspector of Factories, Deputy Chief Inspector of Factories, TNPCB and other statutory authorities,
- Gives a public statement if necessary,
- Keeps record of chronological events and prepares an investigation report and preserve evidence,
- On completion of On Site Emergency and restoration of normalcy, declares all clear and orders for all clear warning.

Incident Controller:

- Assembles the incident control team.
- Directs operations within the affected areas with the priorities for safety to personnel minimize damage to the plant, property and environment and minimize the loss of materials.
- Directs the shutting down and evacuation of plant and areas likely to be adversely affected by the emergency.
- Ensure that key personnel help is sought.
- Provides advice and information to the Fire and Security Officer and the Local Fire Services as and when they arrive.
- Ensures that all non-essential workers/staff of the affected areas evacuated to the appropriate assembly points, and the areas are searched for casualties.
- Has regard to the need for preservation of evidence so as to facilitate any inquiry into the causes and circumstances, which caused or escalated the emergency.
- Co-ordinates with emergency services at the site.
- Provides tools and safety equipment to the team members.
- Keeps in touch with the team and advice them regarding the method of control to be used.
- Keeps the Site Controller of Emergency informed of the progress being made

Emergency Coordinator - Rescue, Fire Fighting:

- Helps the incident Controller in containment of the emergency;
- Ensures fire pumps are in operating conditions and instructs pump house operator to be ready for any emergency with standby arrangement;
- Guides the fire fighting crew i.e. firemen, trained plant personnel and security staff;
- Organizes shifting of the fire fighting facilities to the emergency site, if required;
- Takes guidance of the Incident Controller for fire fighting as well as assesses the requirements of outside help;
- Arranges to control the traffic at the gate and the incident area;
- Directs the security staff to the incident site to take part in the emergency operations under his guidance and supervision;
- Evacuates the people in the plant or in the nearby areas as advised by Site Controller;
- Searches for casualties and arranges proper aid for them;
- Assembles search and evacuation team;
- Arranges for safety equipment for the members of this team;
- Decides which paths the evacuated workers should follow;
- Maintains law and order in the area, and if necessary seeks the help of police.



Emergency Coordinator-Medical, Mutual Aid, Rehabilitation, Transport and Communication:

- In the event of failure of electric supply and thereby internal telephone, sets up communication point and establishes contact with the ECC;
- Organizes medical treatment to the injured and if necessary will shift the injured to nearby hospitals;
- Mobilizes extra medical help from outside, if necessary;
- Keeps a list of qualified first aid providers of the factory and seek their assistance;
- Maintains first aid and medical emergency requirements;
- Makes sure that all safety equipment is made available to the emergency team;
- Assists Site Controller with necessary data and to coordinate the emergency activities;
- Assists Site Controller in updating emergency plan, organizing mock drills verification of inventory of emergency facilities and furnishing report to Site Controller;
- Maintains liaison with Civil Administration;
- Ensures availability of canteen facilities and maintenance of rehabilitation center;
- He will be in liaison with Site Controller/Incident Controller;
- Ensures transportation facility;
- Ensures availability of necessary cash for rescue/rehabilitation and emergency expenditure;
- Controls rehabilitation of affected areas on discontinuation of emergency;
- Ensures availability of diesel/petrol for transport vehicles engaged in emergency operation.

Emergency Coordinator - Essential Services:

- He would assist Site Controller and Incident Controller.
- Maintains essential services like Diesel Generator, Water, Fire Water, Compressed Air/Instrument Air, power supply for lighting.
- He would plan alternate facilities in the event of power failure, to maintain essential services such as lighting, refrigeration plant etc.
- He would organize separate electrical connections for all utilities and emergency services so that in the event of emergency or fires, essential services and utilities are not affected.
- Gives necessary instructions regarding emergency electrical supply, isolation of certain sections etc. to shift in-charge and electricians.
- Ensures availability of adequate quantities of protective equipment and other emergency materials, spares etc.

General Responsibilities of Employees during an Emergency:

During an emergency, it becomes more enhanced and pronounced when an emergency warning is raised, the workers if they are in-charge of process equipment should adopt safe and emergency shut down and attend any prescribed duty as essential employee. If no such responsibility is assigned, he should adopt a safe course to assembly point and await instructions. He should not resort to spread panic. On the other hand, he must assist emergency personnel towards objectives of DMP.

7.6.3.2 Emergency Facilities

Emergency Control Center (ECC):

For the time being, Office Block or a place nearer to the security office is identified as Emergency Control Center. It would have external Telephone, Fax, and Telex facility. All the Site Controller/ Incident Controller Officers, Senior Personnel would be located here. Also, it would be an elevated place.



The following information and equipment are to be provided at the Emergency Control Center (ECC).

- Intercom, telephone
- P and T telephone
- Safe contained breathing apparatus
- Fire suit/gas tight goggles/gloves/helmets
- Hand tools, wind direction/velocities indications
- Public address megaphone, hand bell, telephone directories
- (Internal P and T) factory layout, site plan
- Emergency lamp/torch light/batteries
- Plan indicating locations of hazard inventories, plant control room, sources of safety equipment, work road plan, assembly points, rescue location vulnerable zones, escape routes.
- Hazard chart
- Emergency shut-down procedures
- Nominal roll of employees
- List of key personnel, list of essential employees, list of Emergency Co-ordinators
- Duties of key personnel
- Address with telephone numbers and key personnel, emergency coordinator, essential employees.
- Important address and telephone numbers including Government agencies, neighboring industries and sources of help, out side experts, chemical fact sheets population details around the factory.

Assembly Point:

Number of assembly points depending upon the plant location would be identified wherein employees who are not directly connected with the disaster management would be assembled for safety and rescue. Emergency breathing apparatus, minimum facilities like water etc. would be organized.

In view of the size of plant, different locations are ear marked as assembly points. Depending upon the location of hazard, the assembly points are to be used.

Fire Fighting Facilities:

First Aid Fire fighting equipment suitable for emergency should be maintained in each section in the plant. This would be as per statutory requirements. However, fire hydrant line covering major areas would be laid. It would be maintained at 6- kg/cm² pressure. Fire alarms would be located in the bulk storage areas. Fire officer will be the commanding officer of fire fighting services.

Location of Wind Sock:

On the top of the Administration block and the top of each production blocks, windsocks shall be installed to indicate direction of wind for emergency escape.

Emergency Medical Facilities:

Stretchers, gas masks and general first aid materials for dealing with fire burns would be maintained in the medical center as well as in the emergency control room. Medical



superintendent of the township will be the head of the casualty services ward. Private medical practitioners help would be also are sought. Government hospital would be approached for emergency help.

Apart from plant first aid facilities, external facilities would be augmented. Names of Medical Personnel, Medical facilities in the area would be prepared and updated. Necessary specific medicines for emergency treatment of Burns for Patients and for those affected by toxicity would be maintained.

Breathing apparatus and other emergency medical equipment would be provided and maintained. The help of near by industrial management in this regard would be taken on mutual support basis.

Ambulance:

An ambulance with driver availability in all the shifts and an emergency shift vehicle would be ensured and maintained to transport injured or affected persons. Number of persons would be trained in first aid so that, in every shift, first aid personnel would be available.

7.6.3.3 Emergency Actions

Emergency Warning

Communication of emergency would be made familiar to the personnel inside the plant and people outside. An emergency warning system shall be established.

Emergency Shutdown

There are number of facilities which can be provided to help deal with hazardous conditions, when a tank is on fire. The suggested arrangements are:

1. Stop the production;
2. Dilute contents;
3. Remove heat;
4. Deluge with water; and
5. Transfer contents.

Whether a given method is appropriate depends on the particular case. Cessation of agitation may be the best action in some instances but not in others. Stopping of the feed may require the provision of by pass arrangements.

Methods of removing additional heat include removal through the normal cooling arrangements or use of an emergency cooling system. Cooling facilities, which use vapouring liquid, may be particularly effective, since a large increase in vaporization can be obtained by dropping pressure.

Evacuation of Personnel:

There could be more number of persons in the storage area and other areas in the vicinity. The area would have adequate number of exits and staircases. In the event of an emergency, unconnected personnel have to escape to assembly point. Operators have to take emergency



shutdown procedure and escape. Time Office maintains a copy of deployment of employees in each shift, at ECC. If necessary, persons can be evacuated by rescue teams.

All Clear Signal:

Also, at the end of an emergency, after discussing with Incident Controllers and Emergency Co-ordinators, the Site Controller orders an all clear signal. When it becomes essential, the Site Controller communicates to the District Emergency Authority, Police, Fire service personnel regarding help required or development of the situation into an Off-Site Emergency.

7.6.3.4 General

Employee Information:

During an emergency, employees would be warned by raising siren in specific pattern. Employees would be given training of escape routes, taking shelter, protecting from toxic effects. Employees would be provided with information related to fire hazards, antidotes and first aid measures. Those who would be designated as key personnel and essential employees should be given training to emergency response.

Public Information and Warning:

The industrial disaster effects related to this plant may mostly be confined to the plant area. The detailed risk analysis has indicated that the pool fire effects would not be felt outside. However, as an abundant precaution, the information related to chemicals in use would be furnished to District Emergency Authority for necessary dissemination to general public and for any use during an off site emergency. Factories of this size and nature are in existence in our state since long time.

Co-ordination with Local Authorities:

Keeping in view of the nature of emergency, two levels of coordination are proposed. In the case of an On Site Emergency, resources within the organization would be mobilized and in the event of extreme emergency, local authorities help should be sought.

In the event of an emergency developing into an off site emergency, local authority and District emergency Authority (normally the Collector) would be appraised and under his supervision, the Off Site Disaster Management Plan would be exercised. For this purpose, the facilities that are available locally, i.e. medical, transport, personnel, rescue accommodation, voluntary organizations etc. would be mustered. Necessary rehearsals and training in the form of mock drills should be organized.

Mutual Aid:

Mutual aid in the form of technical personnel, runners, helpers, special protective equipment, transport vehicles, communication facility etc should be sought from the neighboring industrial management.

Mock Drills:

Emergency preparedness is an important step in planning of Industrial Disaster Management. Personnel would be trained suitably and prepared mentally and physically in emergency



response through carefully planned, simulated procedures. Similarly, the key personnel and essential personnel should be trained in the operations.

Important Information:

Once the Plant goes into stream, important information such as names and addresses of key personnel, essential employees, medical personnel, out side the plant, transporters address, address of those connected with Off Site Emergency such as Police, Local Authorities, Fire Services, District Emergency Authority should be prepared and maintained.

7.6.4 Off-Site Emergency Preparedness Plan

7.6.4.1 *Introduction*

Off-site emergency plan follows the on-site emergency plan. When the consequences of an emergency situation go beyond the plant boundaries, it becomes an off-site emergency. Off-site emergency is essentially the responsibility of the public administration. However, the factory management will provide the public administration with the technical information relating to the nature, quantum and probable consequences on the neighboring population.

The off-site plan in detail will be based on those events, which are most likely to occur, but other less likely events, which have severe consequence, will also be considered. Incidents which have very severe consequences yet have a small probability of occurrence should also be considered during the preparation of the plan. However, the key feature of a good off-site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan.

The roles of the various parties who will be involved in the implementation of an off-site plan are described below. Depending on local arrangements, the responsibility for the off-site plan should be either rest with the works management or, with the local authority. Either way, the plan should identify an emergency co-ordinating officer, who would take the overall command of the off-site activities. As with the on-site plan, an emergency control center should be setup within which the emergency co-ordinating officer can operate.

An early decision will be required in many cases on the advice to be given to people living "within range" of the accident - in particular whether they should be evacuated or told to go indoors. In the latter case, the decision can regularly be reviewed in the event of an escalation of the incident. Consideration of evacuation may include the following factors:

- a. In the case of a major fire but without explosion risk (e.g. an oil storage tank), only houses close to the fire likely need to be evacuated, although a severe smoke hazard may require this to be reviewed periodically;
- b. If a fire is escalating and in turn threatening a store of hazardous material, it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people should be advised to stay indoors and shield them from the fire. This latter case particularly applies if the installation at risk could produce a fireball with very severe thermal radiation effects;
- c. For release or potential release of toxic materials, limited evacuation may be appropriate down wind, if there is time. The decision would depend partly on the type of housing "at risk". Conventional housing of solid construction with windows closed



offers substantial protection from the effects of a toxic cloud, while shanty house, which exist close to factories, offer little or no protection.

The major difference between releases of toxic and flammable materials is that toxic clouds are generally hazardous down to much lower concentrations and therefore hazardous over greater distances. Also, a toxic cloud drifting at, say 300 m per minute covers a large area of land very quickly. Any consideration of evacuation should take this into account. Although the plan will have sufficient flexibility built in to cover the consequences of the range of accidents identified for the on-site plan, it will cover in some detail the handling of the emergency to a particular distance from each major hazard works.

7.6.4.2 Aspects Proposed to be considered in the Off-Site Emergency Plan

The main aspects, which should be included in the emergency plan are:

- **Organization**

Details of command structure, warning systems, implementation procedures, emergency control centers.

Names and appointments of incident controller, site main controller, their deputies and other key personnel.

- **Communications**

Identification of personnel involved, communication center, call signs, network, list of telephone numbers.

- **Specialized knowledge**

Details of specialist bodies, firms and people upon whom it may be necessary to call e.g. those with specialized chemical knowledge and laboratories.

- **Voluntary organizations**

Details of organizers, telephone numbers, resources etc.

- **Chemical information**

Details of the hazardous substances stored or procedure on each site and a summary of the risks associated with them.

- **Meteorological information**

Arrangements for obtaining details of weather conditions prevailing at the time and weather forecasts.

- **Humanitarian arrangements**

Transport, evacuation centers, emergency feeding treatment of injured, first aid, ambulances and temporary mortuaries.



- **Public information**

Arrangements for dealing with the media press office and informing relatives, etc.

- **Assessment of emergency plan**

Arrangements for: (a) Collecting information on the causes of the emergency; (b) Reviewing the efficiency and effectiveness of all aspects of the emergency plan.

7.6.4.3 Role of the Emergency Co-ordinating Officer

The various emergency services should be co-ordinated by an Emergency Co-ordinating Officer (ECO), who will be designated by the district collector. The ECO should liaison closely with the site main controller. Again depending on local arrangements, for very severe incidents with major or prolonged off-site consequences, the external control should be passed to a senior local authority administrator or even an administrator appointed by the central or state government.

7.6.4.4 Role of the Local Authority

The duty to prepare the off-site plan lies with the local authorities. The Emergency Planning Officer (EPO) appointed should carry out his duty in preparing for a whole range of different emergencies within the local authority area. The EPO should liaison with the works, to obtain the information to provide the basis for the plan. This liaison should ensure that the plan is continually kept upto date.

It will be the responsibility of the EPO to ensure that all those organizations, which will be involved in off site handling of the emergency situation, know of their role and are able to accept it by having for example, sufficient staff and appropriate equipment to cover their particular responsibilities. Rehearsals for off-site plans should be organized by the EPO.

7.6.4.5 Role of Police

Formal duties of the police during an emergency include protecting life and property and controlling traffic movements.

Their functions should include controlling bystanders, evacuating the public, identifying the dead and dealing with casualties, and informing relatives of death or injury.

7.6.4.6 Role of Fire Authorities

The control of a fire should be normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival at the site. The senior fire brigade officer should also have a similar responsibility for other events, such as explosions and toxic release.

Fire authorities in the region should be appraised about the location of all stores of flammable materials, water and foam supply points, and fire-fighting equipment. They should be involved in on-site emergency rehearsals both as participants, and on occasion, as observers of exercises involving only site personnel.



7.6.4.7 Role of Health Authorities

Health authorities, including doctors, surgeons, hospitals, ambulances, and so on, should have a vital part to play following a major accident, and they should form an integral part of the emergency plan. For major fires, injuries should be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this in all but extreme cases may be generally available in most hospitals. For major toxic releases, the effects vary according to the chemical in question, and the health authorities should be apprised about the likely toxic releases from the plant, which will enable them in dealing with the aftermath of a toxic release with treatment appropriate to such casualties.

Major off-site incidents are likely to require medical equipment and facilities additional to those available locally, and a medical "mutual aid" scheme should exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

7.6.4.8 Role of Government Safety Authority

This will be the factory inspectorate available in the region. Inspectors are likely to satisfy themselves that the organization responsible for producing the off-site plan has made adequate arrangements for handling emergencies of all types including major emergencies. They may wish to see well-documented procedures and evidence of exercise undertaken to test the plan.

In the event of an accident, local arrangements regarding the role of the factory inspector will apply. These may vary from keeping a watching brief to a close involvement in advising on operations in case involvement in advising on operations. In cases where toxic gases may have been released, the factory inspectorate may be the only external agency with equipment and resources to carry out tests.

7.7 Occupational Health and Safety

Large industries, in general and chemical plants in particular where multifarious activities are involved during construction, erection, testing, commissioning, operation and maintenance, the men, materials and machines are the basic inputs. Along with the boons, the industrialization generally bring several problems like occupational health and safety.

The industrial planner, therefore, has to properly plan and take the steps to minimize the impacts of industrialization and to ensure appropriate occupational health and safety plan including fire plans. All these activities again may be classified under construction and erection, operation and maintenance. The proposed safety plan is given below:

7.7.1 Occupational Health

Occupational health needs attention both during construction and erection and operation and maintenance phases. However, the problem varies both in magnitude and variety in the above phases.

- **Erection Phase**

The occupational health problems envisaged at this stage can mainly be due to constructional accident and noise. To overcome these hazards, in addition to arrangements to reduce it within TLV's, personal protective equipment should also be supplied to workers.



- **Operation and Maintenance**

The problem of occupational health, in the operation and maintenance phase is due to noise hearing losses. Suitable personnel protective equipment should be given to employees. The working personnel should be given the following appropriate personnel protective equipment.

- Industrial Safety Helmet
- Crash Helmets
- Face shield with replacement acrylic vision
- Zero power plain goggles with cut type filters on both ends
- Zero power goggles with cut type filters on both sides and blue color glasses
- Welders equipment for eye and face protection
- Cylindrical type earplug
- Ear muffs
- Canister Gas mask
- Self contained breathing apparatus
- Leather apron
- Aluminized fiber glass fix proximity suit with hood and gloves
- Safety belt/line man's safety belt
- Leather hand gloves
- Asbestos hand gloves
- Acid/Alkali proof rubberized hand gloves
- Canvas cum leather hand gloves with leather palm
- Lead hand glove
- Electrically tested electrical resistance hand gloves
- Industrial safety shoes with steel toe
- Electrical safety shoes without steel toe and gum boots

Full fledged hospital facilities should be made available round the clock for attending emergency arising out of accidents, if any. All working personnel shall be medically examined every six months and at the end of his term of employment. This is in addition to the pre-employment medical examination. The fund allocation for occupational health and safety are presented in **Table - 7.13**.

TABLE – 7.13
DETAILS OF FUND ALLOCATION FOR HEALTH AND SAFETY

Sr. No.	Particulars	Fund Allocation/Year (In Lakhs)
1	Employees Health Screening	1,20,000
2	Workplace Safety Responsibility	2,00,000
3	Employees Health and Hygiene	1,80,000
Total		5,00,000

Source: PSPL

7.7.2 Safety Plan

Safety of both men and materials during construction and operation phases is of concern. The preparedness of an industry for the occurrence of possible disasters is known as emergency plan. The disaster in sulphonation plant is possible due to leakage of hazardous chemicals, collapse of structures and fire/explosion etc.

The details of the fire fighting equipments to be installed are given below;



- Dry Chemical Powder (DCP) Fire Extinguisher
- CO₂ Fire Extinguisher
- Foam type Fire Extinguisher
- Soda acid type Fire Extinguisher
- Fire buckets
- Fire Hydrants

Keeping in view the safety requirement during construction, operation and maintenance phases at sulphonation plant, safety policy should be formulated with the following regulations:

- To allocate sufficient resources to maintain safe and healthy conditions of work.
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment.
- To ensure that adequate safety instructions are given to all employees.
- To provide necessary protective equipment, safety appliances and clothing wherever necessary and to ensure their proper use.
- To inform employees about materials, equipment or processes used in their work, which are known to be potentially hazardous to health or safety.
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety.
- To provide appropriate facilities for first aid and prompt treatment of injuries and illness at work.
- To provide appropriate instruction, training, retraining and supervision to employees in health and safety, first aid and to ensure that adequate publicity is given to these matters.
- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service.
- To organize collection, analysis and presentation of data on accident, sickness and incident involving personal injury or injury to health with a view to taking corrective, remedial and preventive action.
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees.
- To publish/notify regulations, instructions and notices in the common language of employees.
- To prepare separate safety rules for each types of occupation/processes involved in a project.
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipment, work places and operations.

7.7.3 Safety Organization

- **Erection Phase**

A qualified and experienced safety officer should be appointed. The responsibilities of the safety officers include identification of the hazardous conditions and unsafe acts of workers and advice on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions.

In addition to employment of safety officer by sulphonation plant, every contractor, who employs more than 250 workers, should also employ one safety officer to ensure safety of the worker, in accordance with the conditions of contract.



- **Operation and Maintenance Phase**

When the construction is completed the posting of safety officers should be in accordance with the requirement of Factories Act and their duties and responsibilities should be as defined there of.

7.7.4 Safety Circle

In order to develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety circles would be constituted in each area of work. The circle would consist of 5-6 employees from that area. The circle normally should meet for about an hour every week.

7.7.5 Safety Training

A full-fledged training center should be set up at the plant. Safety training should be provided by the Safety Officer with the assistance of faculty members called from Corporate Center, Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labors should also be provided safety training. To create safety awareness safety films should be shown to workers and leaflets etc should be distributed. Some of the precautions and remedial measures proposed to be adopted to prevent fires are:

- Compartmentation of cable galleries, use of proper sealing techniques of cable passages and crevices in all directions would help in localizing and identifying the area of occurrence of fire as well as ensure effective automatic and manual fire fighting operations;
- Spread of fire in horizontal direction would be checked by providing fire stops for cable shafts;
- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods for conveyor galleries.
- Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire fighting; and
- Proper fire watching by all concerned would be ensured.

7.7.6 Health and Safety Monitoring Plan

All the potential occupational hazardous work places such as fuel storage, material handling areas should be monitored regularly. The health of employees working in these areas should be monitored once in a month for early detection of any ailment due to exposure to hazardous chemicals.

7.7.6.1 Medical Surveillance

The industry has tie up with the medical center for all the employees health monitoring. All the employees will be examined periodically by the standard qualified doctors once in a month to determine the health status of the workers in respect of occupational health hazard to which they are exposed.

- Hazardous area wise list will be prepared by the medical officers to perform the specific test for the working employees.
- No person will be sign up to operate the crane, locomotive or work-lift or give signals unless his eye sight and color vision will be properly examined by the concern ophthalmologist.



7.7.6.2 Industrial Medical Center Responsibilities

- Surveillance of workers health in relation to work;
- Surveillance of working environments;
- Identification and evaluation of environmental factors which may affect the worker's health;
- Assessment of conditions of occupational workers health; and
- Observance of safety norms and reduce/eliminate exposure to hazardous environs.

7.7.6.3 Employees Training Programme

The industry will provide the certain training program to the working employees. The training programme will includes the hazardous operation, usage of the nose mask and earplugs, Engineering Act and working process in connection with their jobs roles.

7.7.6.4 List of Test for Working Employees

List of test are being conducted for every month to the workers such as:

- X-ray Chest View
- Electro Cardiogram (ECG)
- Eye Fitness
- Spirometry Test
- Audiogram Test

7.7.6.5 Medical Examination

The PSPL will take up medical examination activities periodically to assess hazards due to gases, dusts, vibrations, radiations etc.

7.8 Social Impact Assessment

It has been brought out during the socio-economic survey (based on census data) that non-workers constitute about 58.75% of the total population in 10-km radius study area. Some of them will be available for employment in the proposed unit during construction activities. As the labourers are generally un-skilled, the locals would get opportunities for employment during construction activities. The peak labour force required during the construction period is estimated to be about 120 No's and preference shall be given to local labourers particularly unskilled labours.

In addition to the opportunity of getting employment as construction labourers, the local population would also have employment opportunities in related service activities like petty commercial establishments, small contracts/sub-contracts and supply of construction materials for buildings and ancillary infrastructures etc. Consequently, this will contribute to economic upliftment of the area.

Normally, the construction activity will benefit the local populace in a number of ways, which include the requirement of construction labourers (skilled, semi-skilled and un-skilled), tertiary sector employment and provision of goods and services for daily needs including transport.

In line with the above, some more recommendations are given below:



- Local people shall be given preference for employment;
- All the applicable guidelines under the relevant Acts and Rules related to labour welfare and safety shall be implemented during the construction work;
- The contractor shall be instructed to provide fire wood/kerosene/LPG to the workers to prevent damage to trees; and
- The construction site shall be secured with fencing and shall have guarded entry points.

The proposed project will provide direct employment to about 40 persons and indirect employment to about 50 persons. Apart from the employment and business opportunities for the local people, they will also be benefited in the areas such as education, health care, infrastructure facilities and women empowerment.

7.8.1 Indirect Impacts

- ***Impacts on Public Health and Safety***

The discharge of waste materials (stack emission, wastewater and solid wastes) from process operations can have potential impact on public safety and health. The impact from the discharge of waste products is not expected to be significant since, the adverse impacts on ambient air, water and soil quality are predicted to be below the permissible limits and suitable mitigation measures have envisaged. The public health and safety is dependent on the effective implementation of the control measures suggested by the Pollution Control Committee.

- ***Management of Public Interests***

Based on the analysis of the socio-economic profile of the study area along with the prediction and evaluation of likely impacts arising out of the proposed activity, it has been possible to prepare a feasible environmental management plan. It is felt that this would help in minimizing the adverse impacts on the socio-economic environment to a considerable extent, while at the same time addressing to large extent the aspirations of the community. For the recruitment of semi-skilled and un-skilled workers particularly during construction, preference shall be given to the local people.

7.8.2 Socio Economic Development Activities

The proposed project will provide direct employment to about 35 persons and indirect employment to about 60 persons. Apart from the employment and business opportunities for the local people, they will also be benefited in the areas such as education, health care, infrastructure facilities and women empowerment.

Some of the corporate social responsibility activities proposed under the proposed project with total cost of Rs. 14.4 lakhs are listed below. All the activities will be done within 3 years from the date of commissioning.

- Tree plantation, Bus shelter and safe drinking water facilities for nearby villages.
- A medical camp with free medicine for nearby poor villagers.
- Distribution of free note books for economically poor and financial help for meritorious poor students.



7.9 Rehabilitation & Resettlement Action Plans

The proposed project does not involve any Rehabilitation & Resettlement issues, as the entire land required for the proposed project is available under PSPL.

7.10 Traffic Study

7.10.1 Present Traffic Status

With the proposed project, the transportation is likely to increase during the operational phase, on the nearest road. The influence of the traffic is examined based on adequacy of the existing road network.

The traffic study was co-ordinated to find the existing traffic volume in the NH-66, connecting Chennai to Nagapattinam.

Adequacy of the Existing Road Network

The project site is located at a distance of 3.3 km from NH-66, which is Chennai-Nagapattinam National Highway. The vehicle passing through the road in both ways were counted separately for 24 hours at the junction from 0600 hrs to 0600 hrs (net day) continuously. Vehicle counting has been done and recorded in the traffic volume on hourly basis under respective categories.

The engine driven vehicles were classified into various levels viz., Two wheelers, Auto Rickshaw, Car/ Utility, Buses, Trucks. The traffic computation was organized near the project site on the existing roads to examine the existing traffic details.

The current level of traffic has been converted to Passenger Car Units (PCUs). The PCU factors are considered as 0.75 for two wheelers, 2.0 for auto rickshaw, 1 for car/ utility, 3.7 for Buses and 3.7 for trucks as per the conversion factors specified by the Indian Road Congress (IRC) for urban roads in Plain areas. The existing traffic density is shown in **Table-7.14**. The traffic monitoring location is shown in **Figure-7.1**.

**TABLE - 7.14
TRAFFIC DENSITIES**

Interval	Two Wheeler	Auto Rickshaw	Car/ Utility	Buses	Trucks	Total Vehicles	Total PCUs
6:00 - 7:00	284	116	374	30	132	936	1418.40
7:00 - 8:00	602	192	525	26	122	1467	1908.10
8:00 - 9:00	705	312	805	40	149	2011	2657.05
9:00 - 10:00	714	298	651	34	51	1748	2097.00
10:00 -11:00	794	342	588	42	202	1968	2770.30
11:00 -12:00	770	316	432	36	218	1772	2581.30
12:00 -13:00	692	323	424	33	218	1690	2517.70
13:00 -14:00	608	280	323	28	143	1382	1971.70
14:00 -15:00	754	313	316	39	198	1620	2384.40



Interval	Two Wheeler	Auto Rickshaw	Car/ Utility	Buses	Trucks	Total Vehicles	Total PCUs
15:00 -16:00	752	326	381	59	123	1641	2270.40
16:00 -17:00	692	295	490	46	186	1709	2457.40
17:00 -18:00	845	335	602	33	189	2004	2727.15
18:00 -19:00	1260	414	1124	25	164	2987	3596.30
19:00 -20:00	1062	421	1036	36	118	2673	3244.30
20:00 -21:00	968	339	1003	44	193	2547	3283.90
21:00 -22:00	650	225	357	50	169	1451	2104.80
22:00 -23:00	344	120	290	45	134	933	1450.30
23:00 -24:00	94	34	110	19	78	335	607.40
24:00 - 1:00	60	7	91	10	91	259	523.70
1:00 - 2:00	47	5	43	7	80	182	410.15
2:00 - 3:00	38	4	34	3	62	141	311.00
3:00 - 4:00	34	9	16	5	69	133	333.30
4:00 - 5:00	43	16	52	14	91	216	504.75
5:00 - 6:00	130	26	110	55	125	446	925.50
Total	12,942	5,068	10,177	759	3305	32251	45056.30

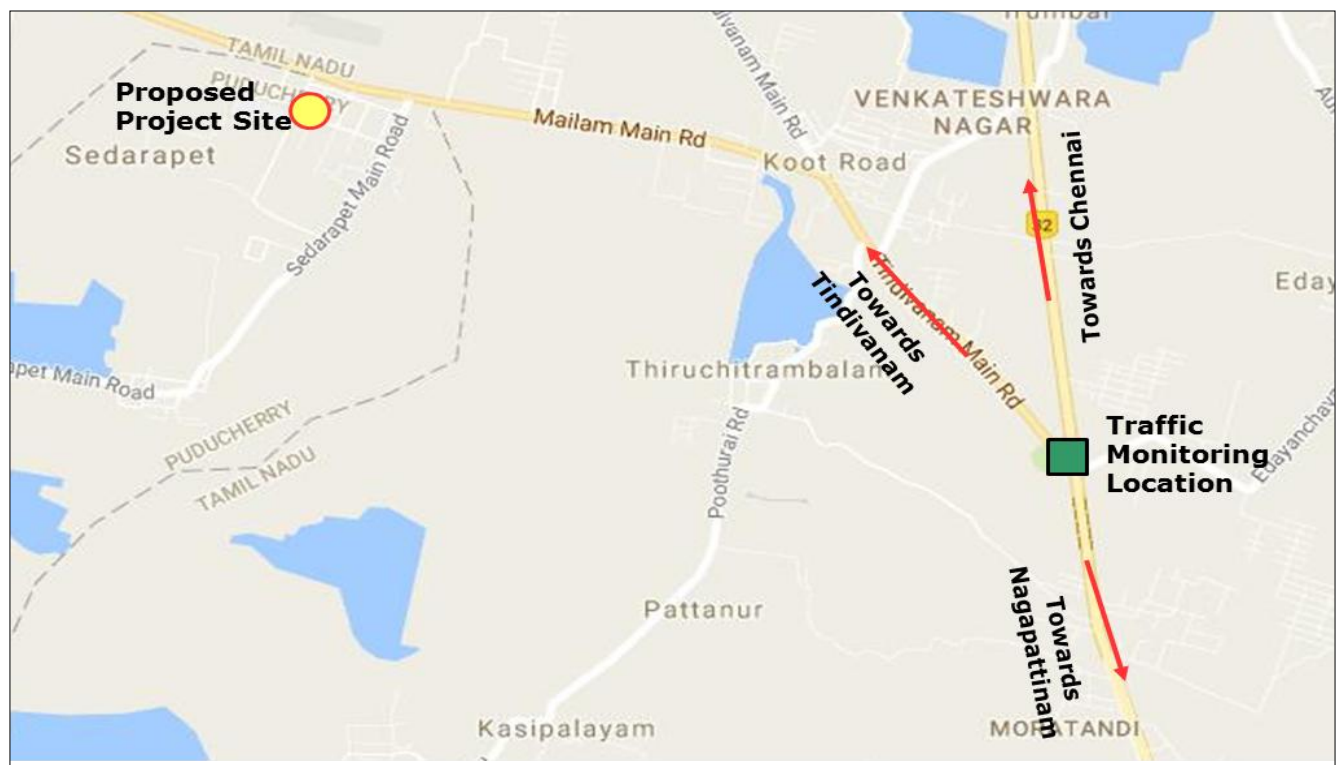


**FIGURE-7.1
TRAFFIC MONITORING LOCATIONS**



Road Geometry

The NH-66 is a four lane road with a width of 23.5 m. The surface condition of the road is good. The existing traffic scenario is presented in **Table-7.15**. The IRC-LOS guidelines are presented in **Table-7.16**.

**TABLE - 7.15
EXISTING TRAFFIC SCENARIO**

Road	Volume (V)	Capacity (C) as per IRC Guidelines	Existing V/C Ratio	LOS
NH-66 (Chennai-Nagapattinam)	1877	3600	0.52	Good

**TABLE - 7.16
IRC- LOS GUIDELINES**

V/C	LOS	Performance
0.0 - 0.2	A	Excellent
0.2 - 0.4	B	Very Good
0.4 - 0.6	C	Good / Average / Fair
0.6 - 0.8	D	Poor
0.8 - 1.0	E	Very Poor
1.0 & above	F	Worst

V = Volume in PCUs/hr & C= Capacity in PCUs/ hr

* Note: Capacity as per IRC Guidelines

7.10.2 Impact of the Traffic to the Transport Conditions

The proposed project involves the transport of raw material to the plant and also the conveyance of employees. The transportation will involve the generation of additional traffic, the details of which are presented in **Table-7.17** and **Table-7.18**.

**TABLE - 7.17
ADDITIONAL TRAFFIC DUE TO PROPOSED PROJECT**

Sr. No.	Vehicle Type	Number of Vehicles per day	PCUs
1.	Cars	50	50
2.	Two Wheelers	100	75
3.	Trucks	10	37
Total		160	162

From the traffic count studies, the present level of traffic on the existing NH- 66 is found to be 1877 PCUs. Considering the proposed project, the proposed ingress and egress of vehicles to & from the project is distributed between 8:00 am to 10:00 am in the morning and 5:00 pm to 7:00 pm in the evening. The total traffic generated from the proposed project is 41 PCUs/ hr. Accordingly, this is added to the existing peak traffic taking place along the roads to obtain the impact on traffic due to the project.



**TABLE - 7.18
TRAFFIC SCENARIO DURING AND AFTER PROPOSED PROJECT**

Road	Volume V	Capacity C as per IRC Guidelines	Existing V/C Ratio	LOS
NH-66 (Chennai-Nagapattinam)	1877+41= 1918	3600	0.53	Good

From the results, it is envisaged that there will not be a significant change in transportation and traffic scenario during the operation stage of the proposed expansion.

7.10.3 Traffic Management Measures

Merging of vehicles will be performed only to left traffic from the exit gates, which ensures safety. Yellow paint junction boxes are painted at the locations to create psychological barrier for through drivers to control the speed. Rubber humps are introduced for the outgoing vehicles at the exit gate drive way. All gates are manned with efficient security who can guide the entry and exit of vehicles.

Adequate sign & guide posts for traffic as per IRC (Indian Roads Congress) and Road marking, STOP lines, parking lanes, slot numbers etc., must be clearly painted so as to guide the vehicles.

CHAPTER-8

PROJECT BENEFITS



8.0 PROJECT BENEFITS

The proposed project aims to meet the demand for the detergent cakes and powders in the markets. The use of Linear Alkyl Benzene Sulphonic Acid (LABSA) in the detergent manufacturing units have substantial demand in the country and has export potential also.

The key benefits are:

- The proposed sulphonation plant will fulfill the demand for the LABSA directly and the demand of detergents indirectly.
- The products of the proposed sulphonation plant will also be exported, which will attract valuable Foreign Exchange.
- The proposed project will help reducing the gap between demand and supply of high concentrate LABSA.

8.1 Improvement in the Physical Infrastructure

The basic requirement of the community needs will be strengthened by extending health care, educational facilities to the community, providing drinking water to the villages, building/strengthening of existing roads in the area.

PSPL will initiate the above amenities either by providing or by improving the facilities in the area, which will help in uplifting the living standards of local communities. The construction of new roads in the project area will enhance the transportation facilities. With improved transportation facilities there is always a scope for development.

8.2 Improvement in the Social Infrastructure

The proposed sulphonation plant will result in improvement of the social infrastructure in following manner:

- Generation of employment and improved standard of living;
- Establishment of small and medium scale soaps & detergent manufacturing enterprises;
- Increased revenue to the state by way of royalty, taxes and duties;
- Superior communication and transport facilities etc.

8.3 Employment Potential

❖ During Operational Phase:

The proposed project will provide employment to persons of different skills and trades. The local population will be given preference to get an employment. The employment potential will ameliorate economic conditions of these families directly and provide employment to many other families indirectly who are involved in business and service oriented activities.

The total manpower required for the proposed project during the operation phase will be about 35 persons for direct activities and about 60 persons for indirect activities which would be mainly sourced from local community in and around the study area and few technical persons will be employed from outside area.



❖ **During Construction Phase:**

An indirect employment for about 120 peoples will be created by the proposed project during the construction phase, which will last for over 6 months from the start of project execution activities at site. These construction workers will be taken from the study area to the extent possible. Hence, the proposed project will benefit locals to a great extent.

8.4 Corporate Social Responsibility Policy

The CSR policy lays down the guidelines and mechanism to carry out CSR projects/programs by PSPL and to report CSR work in the format provided by the rules under the Companies Act 2013.

PSPL has developed the policy in consonance with Section 135, Companies Act 2013 on CSR and in accordance with the CSR Rules notified thereof by the Ministry of Corporate Affairs, Government of India in 2014.

The budgetary allocation for the CSR activities is given in **Table-8.1**.

TABLE-8.1
CORPORATE SOCIAL RESPONSIBILITY ACTION PLAN

Sr. No.	Activity	Investment (Rs. In Lakhs)
1	Tree Plantation	1.0
2	Safe drinking water for nearby villages	3.8
3	Bus Shelters at nearby villages	3.0
4	A medical camp with free medicine for nearby poor villagers	1.5
5	Distribution of free note books for poor and financial help for meritorious poor students	5.0
Total		14.4

Source: PSPL

CHAPTER-9

ENVIRONMENT MANAGEMENT PLAN

9.0 ENVIRONMENT MANAGEMENT PLAN

9.1 Objective

The industrial development in the study area needs to be intertwined with judicious utilization of natural resources within the limits of permissible assimilative capacity. The assimilative capacity of the study area is the maximum amount of pollution load that can be discharged in the environment without affecting the designated use and is governed by dilution, dispersion and removal due to natural physico-chemical and biological processes.

The Environment Management Plan (EMP) is necessary to ensure sustainable development in the area of the proposed project. Hence, it needs to be an all encompassive plan for which the proposed project, Government and Regulating agencies like Pollution Control Committee working in the region and more importantly the affected population of the study area need to extend their cooperation and contribution.

The identification and quantification of impacts based on scientific and mathematical modelling has been presented in *Chapter-4*. The Management Action Plan aims at controlling pollution at the source level to the possible extent with the best available technology.

Environment Management Plan (EMP) is developed to minimize adverse impacts and to ensure that the environment in and around the project site is well protected. The EMP is prepared for construction as well as operation phase of the proposed project.

9.2 Environment Management Plan during Construction Phase

During construction (erection) phase, the construction activities like erection of machineries, transportation of the construction material / proposed machineries cause various impacts on the surroundings.

9.2.1 Air Quality Management

The activities like site development, foundation and vehicular traffic contribute to increase in SPM and NO_x concentration. The mitigation measures recommended to minimize the impacts are:

- Water sprinkling in construction area;
- Asphaltting of roads in the plant area;
- Proper maintenance of vehicles and construction equipment; and
- Tree plantation in the area earmarked for greenbelt development.

9.2.2 Water Quality Management

The soil erosion at site during heavy precipitation contributes to the increase in suspended solids. The mitigation measures recommended to minimize the impacts are:

- Rain Water harvesting system;
- Septic tanks to treat sanitary waste water; and
- Utilizing the wastewater in greenbelt development.

9.2.3 Noise Level Management

The noise impact on the surrounding population during the construction phase will be within the acceptable limits. High noise generating equipment, if used, should not be operated during the night to eliminate any possible discomfort to the nearby residents. Community noise levels are not likely to be affected because of the greenbelt and likely attenuation due to the physical barriers. Ear muffs should be provided to the workers and it should be enforced to be used by the workers.

9.2.4 Ecological Management

The proposed activity will be carried out in an industrially earmarked land. Hence there will be no impact on the terrestrial ecology. Similarly, there will not be any impact on the aquatic ecology as there are no aquatic bodies in the project site. A comprehensive green belt programme will be initiated during construction stage itself, which will improve the ecological condition. No forest land has been utilized for the proposed project, as the entire land required for the project has been already with the management of PSPL.

9.2.5 Socio-Economic Aspects

The proposed activity will be carried out in an industrially notified area. There will not be any Resettlement and Rehabilitation (R & R) issues. Thus, there will not be any adverse socio-economic implications. The economic status of the area is likely to improve as there will be generation of employment during construction period.

9.2.6 Storage of Hazardous Materials

The hazardous materials used during the construction may include petrol, diesel, welding gas and paints. These materials should be stored and handled according to the guidelines specified under Hazardous Wastes Storage, Handling and Transportation Rules of EPA, 1989 Rules. Some of the precautions of storage include the following:

- Dyked enclosures should be provided which should be able to contain complete contents of the largest tank;
- Diesel and other fuels should be stored in separate dyke enclosures;
- Tanks having a diameter of more than 30 m should be separated by fire walls from other storage tanks; and
- The distance between the storage tanks should be at least half their height.

9.2.7 Site Security

Adequate security arrangement should be made to ensure that the local inhabitants and the stray cattle are not exposed to the potential hazards of construction activities.

9.2.8 Migrant Laborers

Safe and secure camping area should be provided for the migrant laborers during the construction period. Adequate arrangements should be made for water supply, sanitation and cooking fuels.

The construction site should be provided with sufficient and suitable toilet facilities for workers to allow proper standards of hygiene. These facilities would be connected to a septic tank and maintained to ensure minimum environmental impact.

9.2.9 Facilities to be provided by the labour contractor during construction phase

The contractor has to provide following facilities to construction work force:

First Aid: At work place, first aid facilities should be maintained at a readily accessible place where necessary appliances including sterilized cotton wool etc. shall be available. Ambulance facilities should be kept readily available at workplace to take injured person to the nearest hospital.

Potable Water: Sufficient supply of water fit for drinking should be provided at suitable places.

Sanitary Facility: Within the precinct of work place, latrines and urinals should be provided at accessible place. These should be cleaned at least twice during working hours and kept in a good sanitary condition. The contractor should conform to sanitary requirements of local medical and health authorities at all times.

Security: Should provide necessary security to work force in coordination with State authorities.

9.3 Environment Management Plan during Operation Phase

During operation phase, the impacts on the various environmental attributes should be mitigated using appropriate pollution control equipment. The Environment Management Plan prepared for the proposed project aims at minimizing the pollution at source.

9.3.1 Air Pollution Management

Adequate and efficient control measures will be installed to keep the gaseous emissions to be minimum. The ambient air quality levels in the surroundings are meeting the prescribed standards for all the pollutants.

The principal air pollution control systems proposed for the sulphonation plant would be Electrostatic Precipitator (ESP) and Alkali Scrubber. The SO₂ and Acid mist released during the sulphonation process would be cleaned by taking the gas through an ESP to remove the acid mist followed by alkali scrubber to remove the SO₂ gas. The clean gas will be discharged into atmosphere through a stack of 35.0 m height.

❖ **Electrostatic Precipitator System**

The Electrostatic Precipitator employs a proprietary electrode design in an air jacketed bank of collection tubes. The High Intensity Torroidal Electron Corona (HITEC) produced by the electrode charges the inlet particulates, which are collected at the passive tube wall. Coalesced organic acids (bottoms) discharge at the bottom of the vessel. Heating or cooling air may be circulated through the collection tube jacket (shell side) to promote tube-side drainage for more viscous materials.

All charged parts of the electrostatic precipitator are constructed of 316 series stainless steel,



and the design includes an internal spray washing system for cleaning the electrodes and vessel internals. Safety interlocks and access way locks are to be provided to ensure the safe operation and maintenance of the unit. The schematic diagram of Electrostatic Precipitator System is shown in **Figure-9.1**.

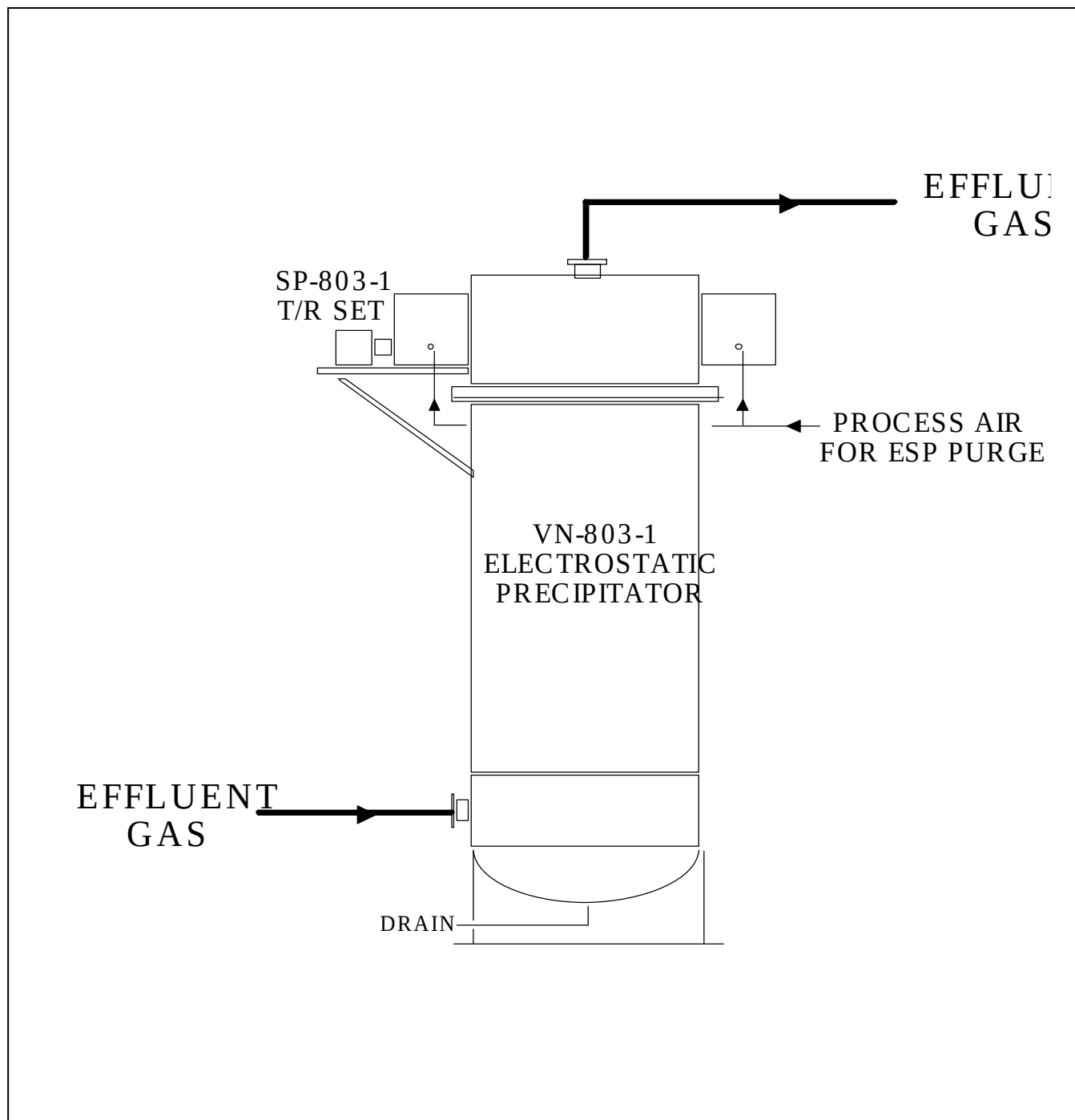


**FIGURE – 9.1
HITEC ELECTROSTATIC PRECIPITATOR (ESP) SYSTEM**



The ESP vessel is designed in several sections with specialized functions. The bottom section contains a gas distribution plate. Gases entering the bottom section are distributed across the vessel into the collection tubes that are mounted vertically in the central section of the ESP vessel. The collection tubes are sealed into a tube sheet at each end so that gases passing through the collection tubes are conveyed to the upper section. The vessel casing of the tube section forms a jacket around the tubes, much like the shell side of a shell and tube heat exchanger. Centered in each collection tube is an electrode mast with seven (7) electrode discs located along its axis. An electric corona discharge is developed around the discs and an electrostatic field drives charged particles from the mast to the tube wall. Mist particles acquire a surface charge from the corona and migrate to the tube wall as a result of the electric field within the tube. Droplets coalesce at the tube wall into a liquid film which drains by gravity, and drips into the bottom head. A steady state liquid discharge begins after several hours of operation. Cleaned gases leave the upper section of the ESP.

The high voltage rectifier and the insulator support housing are located on the top of the ESP tube sheet. To prevent mists of corrosive and conductive materials from wetting the insulators and connections, the heated purge air from the shell of the ESP is used to purge the upper section containing the insulators. The purge blower supplies sufficient air flow around the insulators to protect them from fouling.

Purge Air System

The purge air blower must be kept ON whenever an ESP is in use. The ESP transformer is also interlocked to the main process air blower. A time delay relay is used to allow sufficient time to purge the ESP.

Transformer/Rectifier and Control Panel

Mounted on a supporting steel brace at the vessel top is the Transformer/Rectifier (T/R) Set. This unit converts AC line voltage primary power to high voltage DC power. The T/R set functions in response to the controller circuitry located within the ESP Control Panel. The Control Panel is usually mounted in the control room area, but may be located for convenience near the ESP if desired. The T/R set and the Control Panel each have disconnect switches fitted with key locks. These function to ensure that power is disconnected from the T/R and Control Panel (locked off) whenever the ESP vessel is serviced.

❖ Alkali Scrubber

Effluent process gases leaving the sulfonation system are free of residual SO_3 , but contain any unconverted SO_2 gas and entrained particulate anionic materials (acidic mists of sulfonic acid). This gas stream is not suitable for direct discharge to atmosphere. The exhaust gases from the ESP are passed through an alkali scrubber system. The packed tower SO_2 scrubber system is designed to operate with minimal operator attention as a semi-continuous batch recycle scrubber. The recycle tank is charged with a dilute caustic soda solution which is recirculated to the top of the absorber tower. The gas contacts the scrubbing solution counter-currently as it passes upward through the tower to the final stack.

The SO_2 gas present in the effluent stream is absorbed in the scrubbing solution and reacts with the caustic soda forming Na_2SO_3 . As the caustic soda is consumed, the pH of the scrubbing solution falls, and a pH sensing/transmitter eventually activates an alarm to alert the operation that a new batch of scrubbing solution must be charged to the tank. The batch time is planned so that under normal steady state running conditions, the recycle tank requires caustic and



make-up water addition of not more than once per shift. When caustic is added, the tank is pumped down and recharged with fresh make-up water.

The packed tower SO_2 absorber, or "caustic scrubber," is the final piece of effluent gas-conditioning apparatus in the plant. It follows the electrostatic precipitator and is used to absorb SO_2 in the exhaust gas. The SO_2 absorber consists of a packed tower, recycle tank, a pump for recirculating the scrubbing solution with PH, temperature and pressure monitoring equipment. The schematic diagram of SO_2 scrubber system is shown in **Figure - 9.2**.

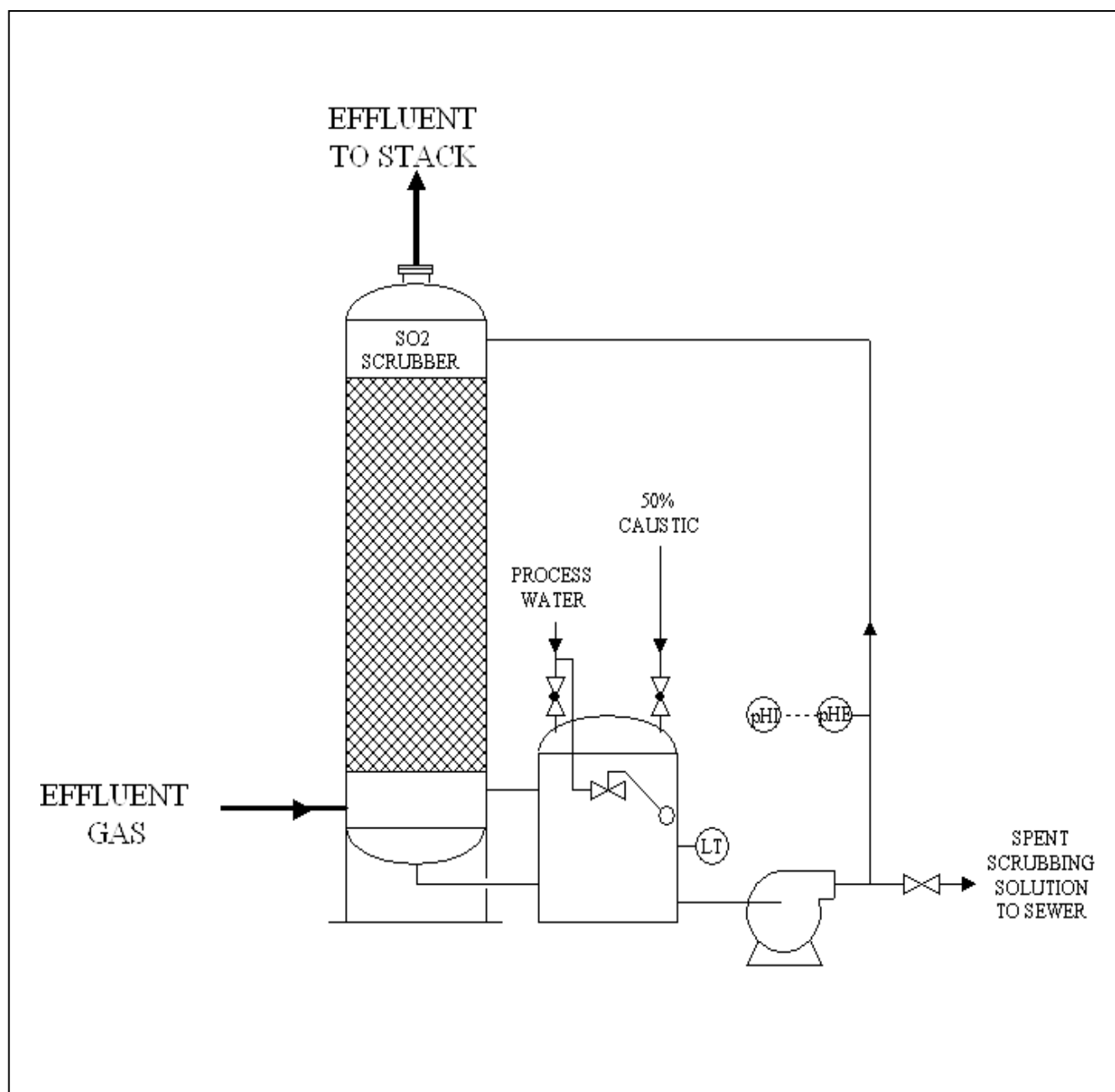


**FIGURE - 9.2
 SO_2 SCRUBBER SYSTEM**



In operation, a dilute caustic solution is re-circulated through the packed tower where it contacts and absorbs the SO₂ in the effluent gas. The caustic reacts to form sodium sulphite, which is then oxidized to sodium sulphate in the absorber. Dilute solutions must be used to prevent salt buildup in the tower during operation. During normal operation, a batch typically lasts six to eight hours. Re-circulation of caustic solution should be set so that the gas pressure drop through the tower is 15 to 20 cm of water. The pH of the scrubbing solution should be maintained above a pH of eight. Typically, when the pH falls below 9 or 10, the spent scrubbing solution is pumped away and the recycle tank is recharged. A pH low alarm alerts the operator to batch out the solution. The packed tower is filled with packing constructed from polypropylene. Under normal operating conditions, the inlet gas temperature will be about 37 to 43°C, and the tower exhaust temperature will be slightly lower due to evaporative cooling.

9.3.2 Wastewater Management

The total water requirement for industrial process (28.9 KLD) and domestic consumption (1.5 KLD) will be sourced from private supplier and PIPDIC respectively. The wastewater generated from the processes will be treated in Effluent Treatment Plant (ETP) of capacity 20 KLD and sanitary wastewater will be treated in the septic tank followed by dispersion trench. The details of sewage and effluent generation are given in **Table-9.1**.

**TABLE – 9.1
DETAILS OF SEWAGE/EFFLUENT GENERATION**

Sr. No.	Description	Total Wastewater Generation (KLD)	Wastewater Management
1.	Domestic Wastewater	1.4	Septic Tank followed by Dispersion Trench
2.	Boiler Blow down	0.3	Treated in ETP
3.	Cooling Tower Blow down	14.0	Treated in ETP
Total		15.7	-

Characteristics of the Effluent

The characteristics of the wastewater generated from Cooling tower / boiler blow down, softener / DM plant regeneration, etc are tabulated in **Table-9.2** and characteristics of the combined effluent is given in **Table-9.3**.

**TABLE – 9.2
EFFLUENT CHARACTERISTICS**

Sr. No.	Parameters	Cooling water blow down	DM water generation	Floor and equipment washing	Boiler blow down
1.	pH	7.5-9.5	3-5	2-3	6-7
2.	Total suspended solids	60-70	40-50	200-300	30-40
3.	Total Dissolved solids	1500-2200	6000-8000	3000-4000	2000-3000
4.	Chlorides	100-150	3000-4000	60-70	1500-1600
5.	BOD	2-3	1-3	3-5	2-5
6.	COD	180	112	110	80
7.	Oil & Grease	5-8	1-5	3-7	2-5
8.	Dissolved Phosphates	3-10	2-3	2-3	1-3
9.	Dissolved Sulphates	10-20	10-15	200-600	10-20



TABLE – 9.3
COMBINED EFFLUENT CHARACTERISTICS

Sr. No.	Characteristic	Value
1	pH	6-8
2	Total suspended solids	40-60
3	Total Dissolved solids	2910-2930
4	Chlorides	600-800
5	BOD	2-3
6	COD	60-120
7	Oil & Grease	1-3
8	Dissolved Phosphates	1-3
9	Dissolved Sulphates	3000-5000

9.3.2.1 Details of Effluent Treatment Plant

The technology proposed for the ETP is chemical precipitation and extended aeration method. Effluents emanating from the various process sections of the sulphonation plant and washing from other sections are segregated and arrive at the screen chamber, then to the collection tank followed by equalization tank. From the equalization tank the homogeneous effluent is pumped in to the Flash mixer. The pH of incoming effluent is checked and hydrated Lime, Alum and polyelectrolyte solutions are added to maintain pH between 7 to 8.

The flash mixing vessel is provided with a stirrer. As soon as the Effluent flows to the flocc-mix tank agitator is started. A predetermined quantity of lime and polyelectrolyte and Alum solutions are dosed to the flash mixer with the help of the respective feed pumps. The effluent mixes with the solutions and overflows to the flocculation zone, where by means of the differential speed agitators flocculation takes place. The pH of the medium has to be controlled between 7 and 7.5 in the flash mixer.

The supernatant from the primary settling tank will be sent to aeration tank and then to secondary settling tank where the entire sludge gets settled down. The treated effluent from the secondary settling tank will be reused for industrial process and gardening purpose. The settled sludge in the primary & secondary settling tanks can be removed by operating the sludge drawn off valves into the sludge pit. The chemical sludge is then taken into the sludge drying beds for dewatering purpose. The dried sludge is periodically cleaned from the top of the sludge drying beds. The proposed Effluent Treatment Plant have the following units as shown in **Table - 9.4**.

TABLE – 9.4
EFFLUENT TREATMENT PLANT

Sr. No.	Name of the unit	No of units	Material of Construction
1	Screen Chamber	1	RCC
2	Collection Tank	1	RCC
3	Equalization tank	1	RCC
4	Flash Mixer	1	MS – FRP
5	Flocculation Tank	1	MS – FRP
6	Primary Settling Tank	1	MS – FRP
7	Aeration Tank	1	RCC
8	Secondary Settling Tank	1	MS – FRP
9	Holding Tank	1	RCC

Sr. No.	Name of the unit	No of units	Material of Construction
10	Lime Solution Tank	1	MS – FRP
11	Polyelectrolyte Tank	1	Sintex
12	Treated Water collection tank	1	RCC
13	Sludge Drying Bed	4	Brick work

The entire treated water of 14.3 KLD, will be reused for industrial process and green belt maintenance. No wastewater will be discharged outside the plant premises. Hence, the proposed unit will achieve zero liquid discharge system. The effluent treatment scheme diagram is given in the **Figure - 9.3**.

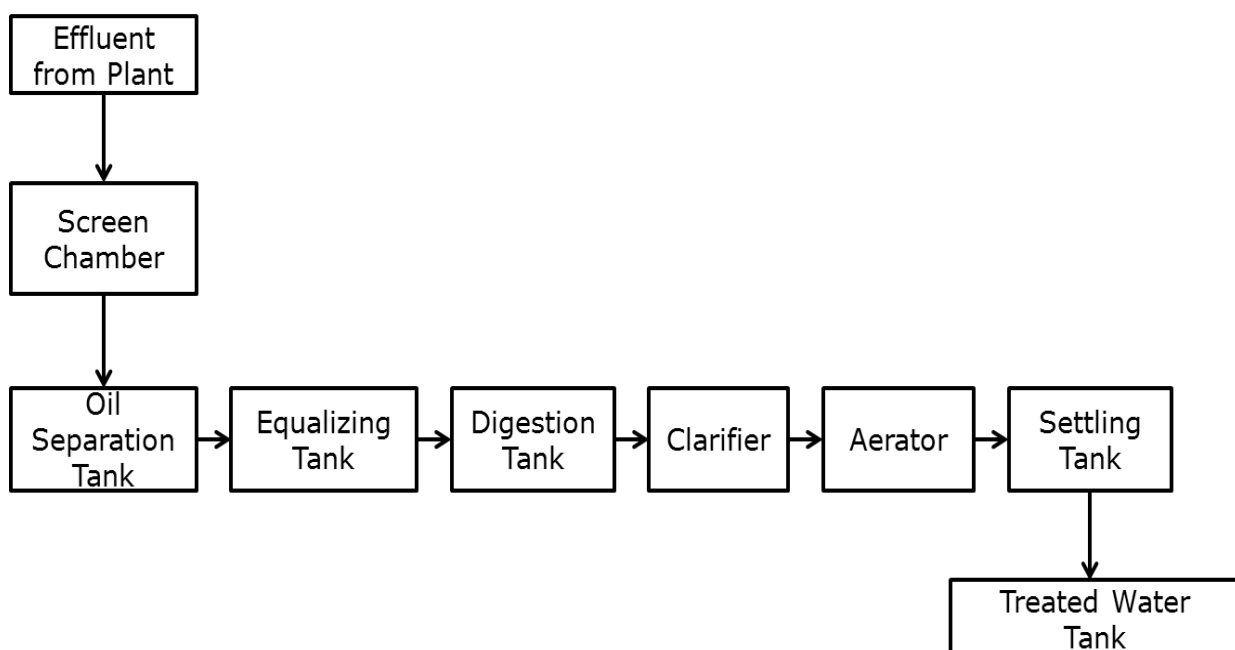


FIGURE – 9.3
EFFLUENT TREATMENT SCHEME

9.3.3 Noise Pollution Management

In the process, various equipments like mixers, sheet cutter, pulverizer, standby DG sets etc. generate the noise. The predicted noise levels after implementation of proposed project will be in the range of 45 dB (A) to 54.5 dB (A) near the plant boundaries in all the directions. The ambient noise levels in the region at most of the places are within the permissible limits. However, the greenbelt provided will reduce the noise levels.

The specifications for procuring major noise generating machines/equipment should include built in design requirements to have minimum noise levels meeting Occupational Safety & Health Association (OSHA) requirement. Appropriate noise barriers/shields, silencers etc. should be provided in the equipment, wherever feasible. As far as possible, noise emanating from noisy equipment should be adequately attenuated by enclosure, insulation etc. The recommendations to mitigate higher noise levels are:

- By adopting new technologies for control of noise in various units;
- The use of damping materials such as thin rubber/lead sheet for wrapping the work places;
- Noise level can be reduced by stopping leakages from compressed air lines and other high pressure equipment;
- By providing padding at various locations to avoid rattling due to vibration;
- Providing noise proof cabins to operators where remote control for operating noise generating equipment is feasible;
- The air compressor, process air blower, pneumatic valves, DG sets should be provided with acoustic enclosure;
- All the design/installation precautions as specified by the manufacturers with respect to noise control shall be strictly adhered to;
- High noise generating sources shall be insulated adequately by providing suitable enclosures;
- Design and layout of building to minimize transmission of noise, segregation of particular items of plant and to avoid reverberant areas;
- Use of lagging with attenuation properties on plant components / installation of sound attenuation panels around the equipment;
- The noise control system will be designed to form an integral part of the plant;
- Other than the regular maintenance of the various equipment, ear plugs/muffs are recommended for the personnel working close to the noise generating units;
- All the openings like covers, partitions shall be designed properly; and
- Inlet and outlet mufflers shall be provided which are easy to design and construct.
- Equipment will be maintained to conform to noise levels prescribed by regulatory authorities;

9.3.4 Solid Waste Management

As per Schedule IV of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, the spent is hazardous and therefore the spent catalyst removed during annual shut-down will be collected in HDPE Bags, packed in drums and will be sent to the supplier for recycling.

The sulphur ash (0.7 TPA) and sulphur sludge (0.003 TPD) will be collected in HDPE Bags, stored in hazardous waste storage room and it will be disposed in the secured land fill facility located at Gummidipoondi. The scrubber residue (4.5 TPA) generated will be concentrated and reused in detergent industry.

9.4 **Greenbelt Development**

9.4.1 **Objective**

Implementation of afforestation program is of paramount importance for any industrial development. In addition to augmenting present vegetation, it will also check soil erosion, make the ecosystem more complex and functionally more stable, make the climate more conducive and restore water balance. It can also be employed to bring areas with special problems under vegetal cover and prevent further land deterioration.

The main objective of the greenbelt is to provide a barrier between the plant and the surrounding areas. The greenbelt helps to capture the fugitive emissions and to attenuate the noise generated in the plant apart from improving the aesthetics of the plant site. Plantation program should be undertaken in all available areas. This should include plantation in the plant premises, along the internal and external roads, along the administrative buildings and other open areas. The tree species selected for greenbelt include the native species.

❖ **Design of Green Belt**

The following guidelines shall be considered in green belt development.

- Shrubs and trees shall be planted in encircling rows around the project site;
- The short trees (<10 m height) shall be planted in the first rows (towards plant side) of the green belt. The tall trees (>10 m height) shall be planted in the outer rows (away from plant side).
- Planting of trees in each row shall be in staggered orientation (Triangular form);
- In the front row, shrubs consisting of Albizia sp., Peltoforum etc. shall be grown;
- Since the trunks of the tall trees are generally devoid of foliage, it will be useful to have shrubs in front of the trees so as to give coverage to this portion; and
- The spacing between the trees shall be maintained slightly less than the normal spaces, so that the trees may grow vertically and slightly increase the effective height of the green belt.

❖ **Plant Species for Green Belt**

While selecting the plant species for the proposed greenbelt, the following points have been taken into consideration:

- Should be a fast growing type;
- Should have a thick canopy cover;
- Should be perennially green;
- Should be preferably of native origin; and
- Should have a large leaf area index.

❖ **Criteria for Selection of Species**

Species to be selected should fulfill the following specific requirements of the area:

- Availability of seed material;
- Tolerance to specific conditions or alternatively wide adaptability to eco-physiological conditions;



- Rapid growth;
- Capacity to endure water stress and climatic extremes after initial establishment;
- Differences in height, growth habits and bole shapes;
- Pleasing appearance;
- Capacity to selectively concentrate some materials from the surroundings;
- Providing shade;
- Large bio-mass and leaf number to provide fodder and fuel;
- Ability of fixing atmospheric Nitrogen;
- Improving waste lands;

❖ **Some Additional Information about Plantation**

To undertake plantation on site for different purposes, following steps will be involved:

- Raising seedlings in nursery;
- Preparation of pits and preparing them for transfer of seedlings; and
- After-care.

❖ **Raising Seedlings in Nursery**

Seedlings should be raised in nurseries. Adequate number of surplus seedlings should be available considering 10% mortality rate in seedlings. Healthy seedlings should be ready for transfer to permanent location before rainy season.

❖ **Preparation of pits and preparing them for transfer of seedlings**

- Standard pit size should be 1 m x 1 m x 1 m;
- The distance between pits would vary depending on their location;
- The pits should be filled using good soil from nearby agricultural fields (3 parts) and Farm yard manure (1 part);
- Rhizobium commercial preparation (1 kg/1000 kg);
- BHC powder, if the soil inhabits white ants (Amount variable); and
- The pits should be watered prior to plantation of seedlings.

❖ **Recommended Species for Plantation**

Based on climate and soil characteristics of the study area, some species are recommended for plantation. In order to have a ground cover, some fast growing species, which do not require watering, have been recommended for mass plantation. The species are as presented below:

- *Acacia farnesiana*
- *Casuarina equisetifolia*
- *Albizia lebeck*
- *Leucena leucopholca*

The above-mentioned species not only resist water stress but also covers the ground quickly and also have wider soil adaptability. For protecting the environment from dust, temperature, chemicals, emissions etc., the following species have been recommended.



Plant species for Plant Area and its Boundary

- *Syzygium cumminii*
- *Casuarina equisetifolia*
- *Eucalyptus hybrid*
- *Cocos nucifera*
- *Artocarpus hetreophylla*
- *Azadirachta indica*
- *Polyalthia longifolira*
- *Thespesia populanea*
- *Bauhinia purpuria*
- *Bauhinia recemosa*
- *Pongamia glabra*
- *Peltophorum ferrusinium*
- *Mangifera indica*
- *Dalberqia sissoo*
- *Tecoma stans*
- *Tectona grandis*
- *Ficus reeligiosa*
- *Somania saman*
- *Mimusops elinqi*
- *Cassia fistula*
- *Bambusa multiplex*
- *Tamarindus indica*

Plant species for Roadside and Avenue plantation

- *Syzygium cumminii*
- *Casuarina equisetifolia*
- *Cocos nucifera*
- *Eucalyptus sp*
- *Artocarpus heterophylla*
- *Tecoma stans*
- *Thespesia populanea*
- *Ancardium occidentale*
- *Mangifera indica*
- *Euphorbia nivula*
- *Pithocolobium dulce*
- *Artocarpus hetreophylla*
- *Azadirachta indica*
- *Polyalthia longifolira*
- *Bauhinia purpuria*
- *Bauhinia recemosa*
- *Pongamia glabra*
- *Peltophorum ferrusinium*
- *Dalberqia sissoo*
- *Tectona grandis*
- *Ficus reeligiosa*
- *Somania saman*
- *Mimusops elinqi*
- *Cassia fistula*
- *Bambusa multiplex*



- *Tamarindus indica*
- *Bauhinia variegata*
- *Barringtonia racemosa*
- *Bombax ceiba*
- *Boswellia serrata*
- *Cordia dichotoma*
- *Delonix regia*
- *Delonix elata*
- *Sesbania grandiflora*
- *Terminalia catapa*
- *Zizhuphus zuzuba*
- *Zizhuphus mauritiana*

9.5 Rain Water Harvesting System

The rainwater will create surface run-off from the proposed project during monsoon season. The run-off will be of two types i.e. run-off from the open surface area of the plant site and run-off from the built-up area of the plant.

The run-off from the building area of the proposed plant facilities will be routed through a carefully designed piping network and collected in the roof water collection sump and the excess water will be connected along with the open storm water network.

The run-off from the open surface area will be routed directly to the rainwater harvesting structures constructed at suitable locations as per the contours. For augmenting the ground water resources in the proposed plant area, adequate number of rainwater harvesting pits will be constructed and the internal drains where rain water flows in excess will be diverted to these pits. These structures will facilitate percolation of water into the ground and thus augmenting the groundwater sources. This will result in increase in Ground Water Level (GWL) and to some extent the ground water quality will be improved.

Rain harvesting system

Keeping in mind the importance of water and its scarcity it is proposed to conserve water by rainwater harvesting by which the subsoil water condition / moisture content is maintained / improved to a great extent.

Run off from the project site is calculated using rational formula:

$$Q = C \times I \times A$$

Where,

Q= Run- off (m³/hr)

A= Catchment area (Roof area, Landscaped area, Road & parking area)

C= Coefficient of Run-off (0.7, 0.3 & 0.9 respectively)

I= Intensity of Rainfall= 111.15 mm/ hr= 0.111 m/ hr

The rainwater harvesting measures and quantity with regards to the various components of the project are presented in **Table-9.5**.



TABLE - 9.5
RAINWATER HARVESTING

Sr. No.	Category	Area (sq.m.)	Impermeability factor	Harvestable water (Intensity x Area x Imp. Factor) cu.m./hr
1.	Building area	2550	0.7	198.135
2.	Landscaped area (Green area, Vacant area)	6520	0.3	217.116
3.	Road/ Surface parking area	---	0.9	---
Total		9070	---	415.251

Considering the constant co- efficient factor of 0.80 (for all situations) for evaporation, spillage and first flush wastage (Source: CPWD)

$$\begin{aligned}\text{Harvestable Water} &= 0.8 \times 415.251 \\ &= 332.20 \text{ cu.m./hr}\end{aligned}$$

All the water shall be routed to rainwater harvesting pits.

- The run- off from terraces, roads, paved area, greenbelt and vacant area will be diverted through storm water network to individual percolation pits proposed along the project periphery and the rain water will be re-charged into underground aquifers.
- A percolation rate of 0.51 is considered with percolation depth as 10 m.
- Run- off = $332.20 \times (1.0 - 0.51) = 162.78 \text{ cu.m./ hr}$.
- Size of percolation pit is 1.20 x 1.20 m and 4.0 m depth.
- Storage volume of each pit= 5.76 m^3 .
- Quantity of Storm water run- off= 162.78 cu.m./ hr
- No. of storage pits required= $162.78 / 5.76 \approx 29 \text{ Nos.}$
- 29 Nos. of percolation pits will be constructed along the project boundary for rain water recharge.

9.6 Institutional Arrangements for Environment Protection

The sulphonation plant will be supervised and controlled by the General Manager supported by DGMs/ AGMs and adequate team of technically and statutorily qualified personnel apart from the operating staff of skilled, semi skilled, unskilled and other categories.

Environment Management Cell will be headed by the General Manager. The organizational structure of the plant is presented in **Figure-9.4**.

The Environmental Engineer / Officer will be responsible for Environment management activities in the sulphonation plant. As Conscious of this, PSPL will create an Environmental Management Cell consisting of officers from various disciplines to co-ordinate the activities concerned with the management and implementation of the environmental control measures.

Basically, this cell will supervise the monitoring of environmental pollution levels viz. ambient air quality, water and effluent quality, noise level either departmentally or by appointing external agencies wherever necessary.



In case the monitored results of environmental pollution found to exceed the allowable limits, the Environmental Management Cell will suggest remedial action and get these suggestions implemented through the concerned authorities.

The environmental management cell will also co-ordinate all the related activities such as collection of statistics of health of workers and population of the region, afforestation and green belt development.

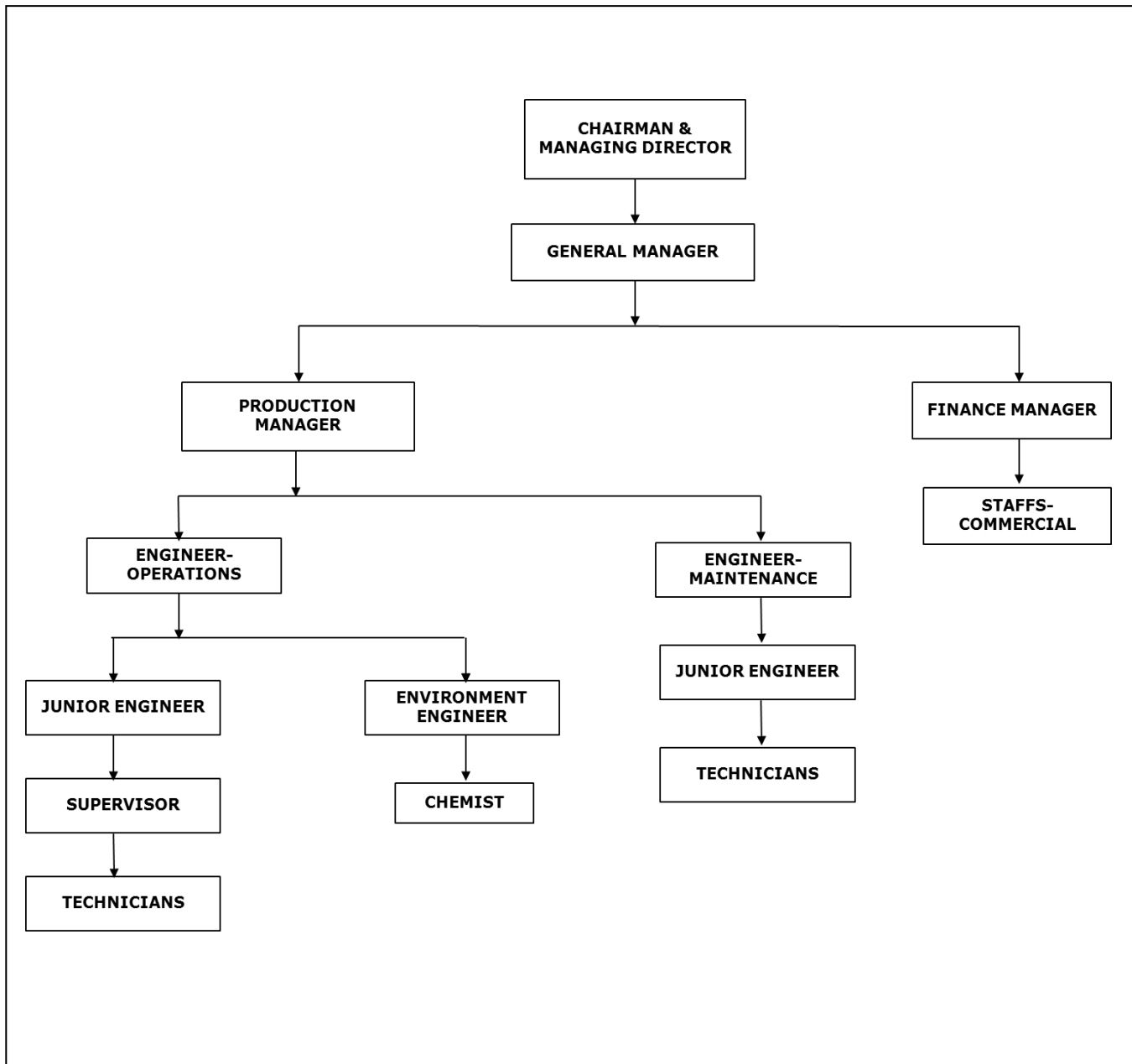


**FIGURE-9.4
ORGANIZATIONAL STRUCTURE**

9.7 Cost Provision for Environmental Measures

The capital cost of the project is about Rs. 575 Lakhs. It is proposed to invest about Rs. 35-Lakhs, i.e. 6.0 % of the capital cost on pollution control, treatment, green belt development, rainwater harvesting, environmental monitoring systems and others. The break-up of the investment is given in **Table - 9.6**.

TABLE - 9.6
COST PROVISION FOR ENVIRONMENTAL MEASURES

Sr. No.	Description of Item	Capital Cost (Rs. in Lakhs)	Recurring Cost (Rs. in Lakhs)
1	Air pollution control systems	13.0	1.6
2	Water pollution control system	9.0	1.4
3	Environmental Monitoring	5.0	0.8
4	Greenbelt development, rainwater harvesting and others	8.0	1.2
Total		35.0	5.0

Source: PSPL

9.8 Implementation Plan for mitigation measures

The mitigation measures suggested above should be implemented so as to reduce the impact on environment due to the operations of the proposed project. In order to facilitate easy implementation, mitigation measures are phased as per the priority of implementation. The priority of the implementation schedule is given in **Table - 9.7**.

TABLE - 9.7
IMPLEMENTATION SCHEDULE

Sr. No.	Recommendations	Time Requirement
1	Air pollution control measures	Before commissioning the proposed activities
2	Water pollution control measures	Before commissioning of the proposed activities
3	Noise control measures	Along with the commissioning
4	Green belt development	Immediately
5	Ecological preservation and upgradation	Stage wise implementation

CHAPTER-10

SUMMARY AND CONCLUSION



10.0 SUMMARY & CONCLUSION

This chapter presents the justification for implementation of the project, summary of anticipated impacts and mitigation measures and conclusions.

10.1 Justification for Implementation of the Project

The proposed plant will have marginal adverse impacts on the local environment. However, with the implementation of the proposed pollution control and environment management measures, the minor impacts anticipated due to construction and operation of the proposed plant will be mitigated.

The proposed project will provide direct employment to about 35 persons and indirect employment to about 60 persons. Apart from the employment and business opportunities for the local people, they will also be benefited in areas such as education, health care and infrastructure facilities.

The Government of Pondicherry will be benefited indirectly in terms of taxes and duties with the railways, ports, industrial authorities, water supplying agencies etc.,

Thus, this project will lead to overall development of the region in particular and the state in general. This project will also generate indirect employment to a considerable number of families, who will render their services for the employees of the project.

Thus, in view of considerable benefits from the project without any major adverse environmental impact, the proposed project is most advantageous to the region as well as to the nation.

10.2 Summary of Anticipated Environmental Impacts and Mitigation Measures

The summary of anticipated adverse environmental impacts due to the proposed project and mitigation measures are given in **Table-10.1**.

**TABLE - 10.1
ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
Constructional Impact				
Water Quality	Increase in suspended solids due to soil run-off during heavy precipitation	Loose soil at construction site	During monsoon season run off from construction site will be routed to a temporary sedimentation tank for settlement of suspended solids.	---
Air Quality	Increase in dust and NOx concentration	Leveling activity and Heavy vehicular movement	Sprinkling of water in the construction area and unpaved roads. Proper maintenance of vehicles will be done.	The impact will be low, as the main approach road will be tarred.
Noise	Increase in noise level	Construction equipment	Equipment will be kept in good condition to keep the noise level within 80 dB (A).	Workers will be provided with necessary protective equipment e.g. ear plugs, earmuffs.



Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
Terrestrial Ecology	Clearing of Vegetation	Soil enabling activities	Landscaping and extensive plantation will be done.	Plantation will be done in consultation with the local forest department.
Operational Impact				
Water Quality	Deterioration of surface water quality	Wastewater discharge from the proposed plant operations	Adequate treatment facilities will be provided so that the treated wastewater confirm to the regulatory standards.	The industrial wastewater after treatment will be reused within the plant premises.
Air Quality	Increase in SO ₂ levels in ambient air	Stack emissions	High efficiency state of art Electrostatic Precipitator (ESP) followed by Alkali Scrubber will be installed to control the acid mist and SO ₂ emissions from the sulphonation plant. Adequate stack height will be provided as per CPCB guidelines for the proper dispersion of pollutants. Mortar able roads in the plant area will be paved to reduce dust emission. Plantation programs will be undertaken around the plant area.	The resultant air quality will confirm to the stipulated standards. SO ₂ emission from sulphonation plant stack will be kept below the standards prescribed by PPCC.
Solid waste	spent catalyst, Sulphur ash & ETP sludge	Production process & ETP	Sulphur ash and ETP sludge will be collected in HDPE Bags & will be stored in hazardous waste storage room, which will be disposed after consultation with PPCC.	Efforts will be made to utilize the solid waste to the extent possible.
Ecology				
a. Terrestrial	Impact on plant species	Emissions from stack	Emission will be controlled as well as dispersed through appropriate stack height design.	As ambient air quality will be within limits, no active injury to the vegetation is expected.
b. Aquatic	Impact on aquatic life of the water bodies	Treated waste water	The wastewater will be provided with adequate treatment facilities and reused within plant premises	As the wastewater will be treated to confirm to prescribed limits, no significant impact on aquatic life is expected.

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
Noise	Increase in noise levels in the plant area.	Equipment in main plant and auxiliaries	Equipment will be designed to conform to noise levels prescribed by regulatory agencies. Provision of green belt and plantation would further help in attenuating noise.	Employees working in high noise areas will be provided with earplugs / earmuffs as a protective device.
Demography and Socio-economics	Strain on amenities like housing, water sources and sanitation, medical and infrastructure facilities.	Influx of people of proposed plant employees as well as contractor's employees/labourers.	Most the workers requirement will be fulfilled by local people. No significant impact is envisaged	Overall socio-economic status of the area is expected to improve.

10.3 Conclusion

The proposed plant will have certain level of marginal impacts on the local environment. However, development of this project has certain beneficial impacts/effects in terms of providing employment opportunities that will be created during the course of setting up as well as during operational phase of the project.

Thus, it can be concluded that with the judicious and proper implementation of the pollution control and mitigation measures, the proposed project will be beneficial to the society and will also help to reduce the demand – supply gap of LABSA and will contribute to the economic development of the region in particular and the country in general.

CHAPTER-11

DISCLOSURE OF CONSULTANT

11.0 DISCLOSURE OF CONSULTANT

11.1 Introduction

VIMTA Labs Limited is a leading multi-disciplinary testing and research laboratory in India. VIMTA provides contract research and testing services in the areas of clinical research, pre-clinical (animal) studies, clinical reference lab services, environmental assessments and analytical testing of a wide variety of products.

VIMTA - Environment Division has been in the forefront of its vision to provide better environment through guiding and assisting the industry for sustainable development. A stalwart in the mission to protect and preserve the natural resources on earth for future generations, Vimta offers extensive research and consultancy services in the field of Environment. With its rich experience, multi-disciplinary expertise and with the support of its state-of-the-art analytical equipment, the services offered by Vimta are wide ranging and encompasses entire gamut of Environment Management and Monitoring Services. With its emphasis on quality services, Vimta, over the years, has evolved itself into a single reference point in India for Comprehensive Environmental Services.

11.2 The Quality Policy

- VIMTA is committed to good professional practices and quality of operations in its testing, validation and research services.
- VIMTA shall ensure customer satisfaction by maintaining independence, impartiality and integrity in its operations.
- VIMTA shall provide the services in accordance with national and international norms.
- VIMTA shall implement quality system as per ISO/IEC 17025 and applicable GLPs & GCPs, to generate technically valid results/data.
- VIMTA shall ensure that all its personnel familiarize with the policies and procedures of the quality system and implement the same in their work.

11.3 Milestones and Accreditations

- 1984 - Registered with an initial investment of Rs.2 Lakhs.
- 1985 - Recognized by ISI (now known as Bureau of Indian Standards).
- 1987 - Qualified by the criteria of Ministry of Environment and Forests was notified as one of the 14 standard Environmental Laboratories published in the Gazettee of India.
- 1988 - Licensed for carrying out tests on Drugs and Pharmaceuticals.
- 1990 - Cherlapally land purchased with plans of larger, more comprehensive facility.
- 1991 - Accredited by NCTCF, DST, Government of India (the forerunner of NABL).
- 1992 - Laboratories shifted to new facility at Cherlapally.
- 1993 - State-of-the-art equipment worth Rs.60 million procured.
- 1995 - Accredited by NABL under its revised scheme, certified by Standards Australia, Quality Assurance Services as per ISO/IEC Guide 25 and ISO 9002.
- 1996 - GLP Compliance.
- 1997 - Restructuring of Vimta from 165 to 100 associates with same performance.
- 1998 - Accreditation by GOSSTANDART and joint venture for certification of Food Exports with ROSTEST, Russia.
- 2001 - World Bank Recognition.
- 2002 - ANVISA Brazil certification.
- 2003 - USFDA accepts Vimta Bioequivalence study report. Showcased Vimta at AAPS



- (USA) and ICSE-CPHI (Germany).
- 2003 - Vimta VHS Research Center inaugurated at Chennai, Launched district laboratories at Visakhapatnam and Vijayawada, Patient service centers launched at 160 locations across the country.
 - 2003 - Vimta Labs Recognized by Saudi Arabian Standards Organization.
 - 2004 - Vimta increases people strength from 225 in 2003 to 400 in 2004. Vimta achieves export turnover of \$ 2.5 million.
 - 2004 - Vimta releases its first fortnightly medical newsletter "Vaidyalekha", Vimta enters Gulf market - bags a contract for Environmental Consultancy in Kuwait.
 - 2004 - Vimta acquires 10.7 acres of land in S.P.Biotech Park - Genome Valley, Hyderabad, to create a world class Research Laboratory of 150000 sq.ft by July 2005.
 - 2004 - Vimta starts a new state of the art speciality services in Molecular Diagnostics at TICEL Bio-Tech Park" at Chennai.
 - 2006 - Vimta expands its overseas activities. Undertakes environmental assignments in Saudi Arabia and Tanzania
 - 2008 - Vimta has been Pre-Qualified by World Health Organization (WHO).
 - 2009-Undertaken Comprehensive Environmental Impact Assessment in Cameroon, Africa
 - 2010 - Accredited by QCI/NABET, Government of India for EIA report preparation
 - 2011- Undertaking environmental and social impact assessment study in Tanzania, Africa as per IFC-World Bank Guidelines

11.4 Management and Board of Directors

1. Dr. S.P. Vasireddi	Chairman and Managing Director
2. Mrs. Harita Vasireddi	Director Projects
3. Mr.V. Harriman	Director - Technical
4. Mr. V.V. Prasad	Executive Director
5. Mr. S. Subrahmanyam	Director
6. Mr. T.S. Ajai	Director
7. Dr. Pavuluri Subba Rao	Director
8. Prof. D. Balasubramanian	Director

11.5 Services Offered

Spread over the 70,000 Sq.ft lush green garden premises at Cherlapally, Hyderabad (India), the scientifically designed and meticulously groomed infrastructural facility of the Central Laboratory of **VIMTA** has the most sophisticated instruments backed by an excellent team of professionals. The 40,000 Sq.ft, three-storied, 120 roomed, centrally air conditioned state-of-the-art Laboratory equipped with Rs.100 million worth analytical instruments and computerized data management systems, all under one roof is perhaps the only one of its kind in South Asia in the contract testing and research sector.

Vimta offers various services under the following divisions:

- Environment;
- Analytical;
- Clinical Reference Lab; and
- Clinical Research.

The environment division of VIMTA Labs Limited (Vimta) has its presence all over India including a strong association with international consultants like Japan Bank for



International Cooperation (JBIC), Kennametal Inc. - USA, BBL - UK, Rudal Blanchard - UK, E&E Solutions - Japan, NEPESCO & KNPC - Kuwait, Marafiq - Saudi Arabia and others. Vimta has the following credentials:

- Recognitions by BIS;
- Recognitions by Ministry of Environment and Forests, Govt. of India;
- Recognitions by State Pollution Control Boards (wherever applicable) ;
- Recognitions by Department of Science & Technology, Govt. of India (NABL) ;
- Recognitions by Ministry of Defense, Govt. of India;
- Recognitions by APEDA, Ministry of Commerce, Govt. of India;
- Recognitions by Saudi Arabia Standard Organization (SASO), Saudi Arabia;
- Recognitions from NEMC, Tanzania;
- Accreditations by NCTCF;
- Certification from Standard Australia;
- Recognition from ANVISA Brazil;
- Quality Assurance Services as per ISO/IEC 17025; and
- Quality Assurance Services as per ICH Guidelines

11.6 Services

Environment essentially being a multi-disciplinary science, the range of services offered by the Division are also comprehensive and caters to the needs of industry, pollution control agencies, regulatory authorities and in a larger pursuit of a green globe. The services under Environmental Assessments include:

- Site Selection and Liability Studies;
- Environmental Impact Assessments;
- Environment Management Plans;
- Carrying Capacity based Regional Studies;
- Environmental Audits;
- Solid and Hazardous Waste Management;
- Risk Assessment (MCA,HAZON,HAZOP) & DMP;
- Occupational Health and Safety, Industrial Hygiene;
- Environmental Monitoring for Air, Meteorology, Water, Soil, Noise, Ecology and Socio-Economic;
- Industrial Emission Source Monitoring;
- Offshore Sampling and Analysis of Marine Water and Sediments;
- Marine Ecological Studies;
- Marine Impact Assessment;
- Rehabilitation and Resettlement Studies;
- Forestry and Ecological Studies;
- Geological and Hydro-geological Studies;
- Land Use /Land Cover Studies based on Remote Sensing;
- Socio-Economic Studies;
- Due Diligence Studies;
- Epidemiological Studies;
- Wasteland Management Studies; and
- Study on Bio-indicators.

The services under Environmental Chemistry include:

- Analysis of Water, Wastewater, Soil, Solid Waste, Hazardous waste as per Indian and International Codes;



- Source Emissions and Work Zone Air/Noise quality monitoring;
- Analysis of SVOCs, VOCs, PAH, BTEX, AOX, PCB's, TCLP metals, TOC etc.;
- Categorization of Hazardous Waste; and
- Pesticide Residue Analysis.

11.7 Facilities

Vimta-Environment Division is located in scientifically designed Central Laboratory with the state-of the-art modern facilities to offer wide range of services in indoor and outdoor monitoring and analytical characterization in the field of Environment. Further, it is ably supported by highly skilled and experienced team of professionals in the fields of Science, Engineering, Ecology, Meteorology, Social Planning, Geo & Hydro-geology, and Environmental Planning.

Besides the regular monitoring equipment such as Respirable Dust Samplers, Automatic Weather Monitoring Stations, Stack Monitoring Kits, Personal Samplers, Noise Meters, Portable Water Kits etc, the other major specialized equipment include:

- Monostatic Sodar–Designed by National Physical Laboratory, GOI;
 - Integrated Noise Level Meter–Quest, U.S.A;
 - Flue Gas Analyzers–Testo, Germany;
 - 113-A Gravimetric Dust Sampler-Casella, London;
 - ICP AES– Varian, USA;
 - Gas Liquid Chromatographs with FID, ECD & pFPD–Varian, USA;
 - Gas Chromatograph with Mass Detector–Varian, USA;
 - Atomic Absorption Spectrometer [AAS]–Varian, USA;
 - PAS-AFC-123 instrument;
 - High Performance Liquid Chromatograph;
 - Laser Particle Size Analyzer;
-
- ❖ Monostatic Sodar – Designed by National Physical Laboratory, GOI;
 - ❖ Integrated Noise Level Meter–Quest, U.S.A;
 - ❖ Flue Gas Analyzers–Testo, Germany;
 - ❖ 113-A Gravimetric Dust Sampler-Casella, London;
 - ❖ ICP AES– Varian, USA;
 - ❖ Gas Liquid Chromatographs with FID, ECD & pFPD–Varian, USA;
 - ❖ Gas Chromatograph with Mass Detector–Varian, USA;
 - ❖ Atomic Absorption Spectrometer [AAS]–Varian, USA;

11.8 Quality Systems

The fact that Environment division and its supporting Site Laboratories are accredited by NABL (ISO-17025) and Ministry of Environment and Forests and by other international bodies such as Asian Development Bank (ADB) and World Bank stands testimony to its emphasis on Quality Systems.

11.9 Achievements

Being the first laboratory to be recognized under Environment Protection (EP) Act by GOI in 1986, Environment Division with its best mind power and industrial knowledge competency that allows it to compare with the best in the business.



- The Environment Division till date has executed about 350 Environmental Impact Assessment (EIA) and Environment Management Studies with Risk Assessment and Disaster Management Plans and obtained statutory approvals.
- Supported by the strong modern laboratory support and experienced hands, Environment division is well equipped in conducting Due Diligence, Phase-I and Phase-II studies.
- Undertaken specialized studies such as Regional Environmental Impact Assessment on Carrying Capacity Principle; Upper Air Meteorological studies using SODAR for major Industrial Complexes.
- Associated with prestigious studies such as Environmental Pollution monitoring around Taj Trapezium, Pre and Post Satellite launch studies for SHAR, ISRO and monitoring for offshore Oil & Gas exploration for deep-sea water and sediment sampling.
- The services offered include wide spectrum of industries covering Power, Chemical, Cement, Mining, Steel & Alloys, Metallurgical, Dye & Intermediates, Bulk Drugs, Pesticides, Agro-Chemicals, Petro-Chemicals, Refineries, Pulp & Paper, Oil & Gas Exploration & Production, Asbestos, Infrastructure, River valley, Foundries etc.
- The Environment division has also offered its services to major infrastructure projects such as Ports, Oil & Gas Pipelines, Green field Air Ports, Roads and Highways.



DETAILS OF PERSONNEL INVOLVED IN CURRENT EIA REPORT

Sr. No.	Name	Qualification	Position	Contribution	Experience
1	Mr. M. Janardhan	M.Tech (Env)	Head & Vice President (Env)	Co-ordination	About 24 years of experience in the field of air quality impacts, and noise, environmental management and environmental engineering
2	Dr. K.S. Muneeswaran	M.E. (Env. Engg), M.Sc., Ph.D	Senior Manager/ Senior Scientist	Co-ordination	About 26 years of experience in the field of environmental chemistry and environmental impact assessment
3	Dr. B. Chandra Sekhar	M.Sc, Ph.D	Sr. Manager	Co-ordination	About 14 years of experience in the field of environmental management and modelling
3	Mr. G.V. Raghava Rao	M.Tech (Env)	Group Leader	Expert	About 17 years of experience in the field of Environmental Engineering & Management
4	Ms. Durga Bhavani	M.Tech (Env)	Group leader	Expert	About 13 years of experience in the field of environmental impact assessment
5	Mr. S. Kishore Kumar	M.Tech (Env)	Env Engineer	Expert	About 6 years of experience in the field of Environmental Impact Assessment studies
6	Mr. P.Niranjan Babu	B.Com	Asst Manager	Secretarial	About 23 years of experience in the field of Environmental Monitoring and secretarial assistance
7	Dr. Subba Reddy	M.Sc., Ph.D	Scientist	Expert	About 8 years of experience in the field of Environmental Impact Assessment studies
8	Mr. Rajashekhar	M.Sc., Ph.D	Ecologist	Expert	About 10 year of experience in the field of environmental monitoring and environmental impact assessment
9	Mr. S. Srinivas Goud	M.S.W	Group Leader	Expert	About 14 year of experience in the field of social impact assessment
10	Mr. J. Bharatvaj	M.E., (Env. Engg)	Env. Engineer	Expert	About 3 year of experience in the field of environmental monitoring and environmental impact assessment
11	Mr. R. Vignesh	M.Tech., (Env. Engg)	Env. Engineer	Expert	About 1 year of experience in the field of environmental monitoring and environmental impact assessment
11	Dr. Subba Reddy	M.Sc., Ph.D	Scientist	Expert	About 8 years of experience in the field of Environmental Impact Assessment studies
12	Mr. G. Krishnamoorthy	M.Sc., (Env. Sci)	Scientist	Expert	About 5 years of experience in the field of Environmental Science and monitoring
13	Mr. C. Yathavaraj	M.Sc., (Env. Sci)	Scientist	Expert	About 4 years of experience in the field of Environmental Science and monitoring
14	Mr. A. Ashok	B.Tech (Biotechnology)	Jr. Env. Engineer	Expert	About 3 year of experience in the field of Environmental Science and monitoring
15	Mr. T.Karthikeyan	B.Tech (Biotechnology)	Jr. Env. Engineer	Expert	About 4 year of experience in the field of Environmental Science and monitoring
16	Mr. P. Krishna	I.T.I (Civil)	Sr. Draftsman	Cartography	About 14 years of experience in the field of Environmental and Civil Drawings
17	Mr. J. Ramakrishna	I.T.I (Civil)	Sr. Draftsman	Cartography	About 13 years of experience in the field of Environmental and Civil Drawings
Empaneled Experts					
1	Mr. J. Rajendra Prasad	M.Sc	Consultant	Expert	About 13 years of experience in the field of Remote sensing, Hydrogeology
2	Mr. J. Rajgopal Krishnan	M.Tech (Chem. Engg)	Consultant	Expert	About 40 years of experience in the field of risk and hazard assessment



National Accreditation Board for Education & Training



Quality Council of India

CERTIFICATE OF ACCREDITATION

M/s Vimta Labs Limited

142, IDA, Phase – II, Cherlapally, Hyderabad – 500051

*is hereby accorded accreditation under the QCI-NABET Scheme for Accreditation of EIA
Consultant Organizations (Rev. 09, August 2011) for the following scope:*

Sl. No.	Name of the Sector	Cat.
1.	Mining of Minerals including Opencast/ Underground mining	A
2.	Offshore and onshore oil and gas exploration, development & production	A
3.	Thermal Power Plants	A
4.	Coal washeries	A
5.	Metallurgical industries (ferrous & non-ferrous) – both primary and secondary	A
6.	Cement Plants	A
7.	Asbestos milling and asbestos based products	A
8.	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	A
9.	Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passing through national parks/ sanctuaries/ coral reefs /ecologically sensitive areas including LNG terminal	A
10.	Air ports	A
11.	Industrial estates/ parks/ complexes/areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes	A
12.	Building and large construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions	B
13.	Townships and Area development projects	B

Name of approved EIA Coordinators & Functional Area Experts are given in minutes of AC Meeting dated Oct 04, 2013; Oct 15 and Nov 26, 2014 posted on QCI website

Accreditation to the above Sectors is subject to the EIA reports being prepared by the experts (EIA Coordinators & Functional Area Experts) mentioned in the above minutes and compliance to the Terms and Conditions of Accreditation.

Certificate No: NABET/ EIA/ 1316/ RA003

Valid up to: Sep. 19, 2016

Life Saha
C.E.O.



(Please refer <http://nabet.qci.org.in/environment/> for latest status of accreditation)

Note

- Subject to continual compliance to NABET Scheme including Surveillance Assessment
- Updated status of accreditation available at www.qcin.org every 5th of the month



ANNEXURE-I

GENERAL AND SPECIFIC TOR

5(f):STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR SYNTHETIC ORGANIC CHEMICALS INDUSTRY (DYES & DYE INTERMEDIATES; BULK DRUGS AND INTERMEDIATES EXCLUDING DRUG FORMULATIONS; SYNTHETIC RUBBERS; BASIC ORGANIC CHEMICALS, OTHER SYNTHETIC ORGANIC CHEMICALS AND CHEMICAL INTERMEDIATES) AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

A. STANDARD TERMS OF REFERENCE

- 1) Executive Summary
- 2) Introduction
 - i. Details of the EIA Consultant including NABET accreditation
 - ii. Information about the project proponent
 - iii. Importance and benefits of the project
- 3) Project Description
 - i. Cost of project and time of completion.
 - ii. Products with capacities for the proposed project.
 - iii. If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.
 - iv. List of raw materials required and their source along with mode of transportation.
 - v. Other chemicals and materials required with quantities and storage capacities
 - vi. Details of Emission, effluents, hazardous waste generation and their management.
 - vii. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)
 - viii. Process description along with major equipments and machineries, process flow sheet (quantative) from raw material to products to be provided
 - ix. Hazard identification and details of proposed safety systems.
 - x. Expansion/modernization proposals:
 - c. Copy of all the Environmental Clearance(s) including Amendments thereto obtained for the project from MOEF/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

addition, status of compliance of Consent to Operate for the ongoing /existing operation of the project from SPCB shall be attached with the EIA-EMP report.

- d. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.

4) Site Details

- i. Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.
- ii. A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places)
- iii. Details w.r.t. option analysis for selection of site
- iv. Co-ordinates (lat-long) of all four corners of the site.
- v. Google map-Earth downloaded of the project site.
- vi. Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.
- vii. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.
- viii. Landuse break-up of total land of the project site (identified and acquired), government/private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area)
- ix. A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area
- x. Geological features and Geo-hydrological status of the study area shall be included.
- xi. Details of Drainage of the project upto 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (mega green field projects)
- xii. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.
- xiii. R&R details in respect of land in line with state Government policy.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- 5) Forest and wildlife related issues (if applicable):
- i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable)
 - ii. Landuse map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (in case of projects involving forest land more than 40 ha)
 - iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.
 - iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon.
 - v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area.
 - vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife.
- 6) Environmental Status
- i. Determination of atmospheric inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.
 - ii. AAQ data (except monsoon) at 8 locations for PM10, PM2.5, SO2, NOX, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.
 - iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQQM Notification of Nov. 2009 along with - min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.
 - iv. Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.
 - v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC, if yes give details.
 - vi. Ground water monitoring at minimum at 8 locations shall be included.
 - vii. Noise levels monitoring at 8 locations within the study area.
 - viii. Soil Characteristic as per CPCB guidelines.
 - ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.
- xi. Socio-economic status of the study area.

7) Impact and Environment Management Plan

- i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.
- ii. Water Quality modelling - in case of discharge in water body
- iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined.
- iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.
- v. Details of stack emission and action plan for control of emissions to meet standards.
- vi. Measures for fugitive emission control
- vii. Details of hazardous waste generation and their storage, utilization and management. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.
- viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.
- ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.
- x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.

- xi. Total capital cost and recurring cost/annum for environmental pollution control measures shall be included.
- xii. Action plan for post-project environmental monitoring shall be submitted.
- xiii. Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.

8) Occupational health

- i. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers
- ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.
- iii. Details of existing Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved,
- iv. Annual report of health status of workers with special reference to Occupational Health and Safety.

9) Corporate Environment Policy

- i. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.
- ii. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.
- iii. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.
- iv. Does the company have system of reporting of non compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- 10) Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.
- 11) Enterprise Social Commitment (ESC)
 - i. Adequate funds (at least 2.5 % of the project cost) shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon.
- 12) Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.
- 13) A tabular chart with index for point wise compliance of above TOR.

B. SPECIFIC TERMS OF REFERENCE FOR EIA STUDIES FOR SYNTHETIC ORGANIC CHEMICALS INDUSTRY (DYES & DYE INTERMEDIATES; BULK DRUGS AND INTERMEDIATES EXCLUDING DRUG FORMULATIONS; SYNTHETIC RUBBERS; BASIC ORGANIC CHEMICALS, OTHER SYNTHETIC ORGANIC CHEMICALS AND CHEMICAL INTERMEDIATES)

1. Details on solvents to be used, measures for solvent recovery and for emissions control.
2. Details of process emissions from the proposed unit and its arrangement to control.
3. Ambient air quality data should include VOC, other process-specific pollutants* like NH₃*, chlorine*, HCl*, HBr*, H₂S*, HF*, etc., (*-as applicable)
4. Work zone monitoring arrangements for hazardous chemicals.
5. Detailed effluent treatment scheme including segregation of effluent streams for units adopting 'Zero' liquid discharge.
6. Action plan for odour control to be submitted.
7. A copy of the Memorandum of Understanding signed with cement manufacturers indicating clearly that they co-process organic solid/hazardous waste generated.
8. Authorization/Membership for the disposal of liquid effluent in CETP and solid/hazardous waste in TSDF, if any.
9. Action plan for utilization of MEE/dryers salts.
10. Material Safety Data Sheet for all the Chemicals are being used/will be used.
11. Authorization/Membership for the disposal of solid/hazardous waste in TSDF.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

12. Details of incinerator if to be installed.
13. Risk assessment for storage and handling of hazardous chemicals/solvents. Action plan for handling & safety system to be incorporated.
14. Arrangements for ensuring health and safety of workers engaged in handling of toxic materials.

J-11011/32/2016-IA II (I)
Government of India
Ministry of Environment, Forest and Climate Change
(I.A. Division)

Indira Paryavaran Bhawan
Aliganj, Jorbagh Road
New Delhi – 110 003

E-mail : lk.bokolia@nic.in
Telefax: 011-24695313
Dated: 11th May, 2016

To,
Shri Sunjai
General Manager
M/s Power Soaps Pvt. Ltd.
94/1, Sembiapalayam, Korkadu Post,
Puducherry- 605110

Email.: Nil. ; Fax.: Nil

Subject: Setting up of Sulphonation plant 72 TPD (18,000 TPA) of 96% Linear Alkyl Benzene Sulphonic Acid (LABSA) at PIPDIC Industrial Estate, Sedarapet, Pondicherry by M/s Power Soap Limited- reg. TOR

Ref. No.: Your Proposal no. IA/PY/IND2/39193/2016; dated 11th January, 2016

Sir,

Kindly refer your proposal no. IA/PY /IND2/39193/2015 dated 11th January, 2016 along with project documents including Form-I, Pre-feasibility Report and draft 'Terms of Reference' as per the EIA Notification, 2006. It is noted that the proposal is for setting up of Sulphonation plant 72 TPD (18,000 TPA) of 96% Linear Alkyl Benzene Sulphonic Acid (LABSA) at PIPDIC Industrial Estate, Sedarapet, Pondicherry by M/s Power Soap Limited. Following products will be manufactured:

Sr. No.	Product	Capacity
1.	Linear Alkyl Benzene Sulphonic Acid	72 TPD

2.0 Draft Terms of Reference (TOR) have been discussed and finalized during 6th Expert Appraisal Committee (Industry-2) meeting held during 30th March- 2nd April, 2016 for preparation of EIA/EMP report. The Committee prescribed the following Specific and Additional TOR in addition to Generic TOR provided at Annexure-I (refer to Ministry's website) for preparation of EIA-EMP report:

A. Specific TOR

1. Details on solvents to be used, measures for solvent recovery and for emissions control.
2. Details of process emissions from the proposed unit and its arrangement to control.
3. Ambient air quality data should include VOC, etc.,
4. Work zone monitoring arrangements for hazardous chemicals.
5. Detailed effluent treatment scheme including segregation of effluent streams for units adopting 'Zero' liquid discharge.
6. Action plan for odour control to be submitted.
7. Details of Incinerator alongwith pollution control device to be provided.
8. A copy of the Memorandum of Understanding signed with cement manufacturers indicating clearly that they co-process organic solid/hazardous waste generated.

9. Authorization/Membership for the disposal of liquid effluent in CETP and solid/hazardous waste in TSDF, if any.
10. Material Safety Data Sheet for all the Chemicals are being used/will be used.
11. Authorization/Membership for the disposal of solid/hazardous waste in TSDF are being used/will be used.
12. Authorization/Membership for the disposal of solid/hazardous waste in TSDF.
13. Risk assessment for storage and handling of hazardous chemicals/solvents. Action plan for handling & safety system to be incorporated.
14. Arrangements for ensuring health and safety of workers engaged in handling of toxic materials.

B. Additional TOR

- i. Public hearing to be conducted and issues raised and commitments made by the project proponent on the same should be included in EIA/EMP Report in the form of tabular chart with financial budget for complying with the commitments made.
- ii. A copy of application submitted to NBWL seeking wildlife clearance due to Ousudu Bird Sanctuary.

3.0 These 'TORs' should be considered for the preparation of EIA/EMP for setting up of Sulphonation plant 72 TPD (18,000 TPA) of 96% Linear Alkyl Benzene Sulphonic Acid (LABSA) at PIPDIC Industrial Estate, Sedarapet, Pondicherry by M/s Power Soap Limited in addition to all the relevant information as per the 'General Structure of EIA' given in Appendix III and IIIA in the EIA Notification, 2006. The EIA/EMP as per TORs should be submitted to the Chairman, Gujarat Pollution Control Board, for public consultation. The SPCB shall conduct the public hearing/public consultation as per the provisions of EIA notification, 2006.

4.0 You are requested to kindly submit the final EIA/EMP prepared as per TORs and incorporating all the issues raised during Public Hearing / Public Consultation to the Ministry for considering the proposal for environmental clearance ***within 3 years as per the MoEF O.M. No. J-11013/41/2006-IA.II (I) dated 8th October, 2014.***

5.0 The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/ National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other Organization(s)/Laboratories including their status of approvals etc.



(Lalit Bokolia)
Additional Director

Copy to:

- 1 The Member Secretary, Pondicherry Pollution Control Committee, Department of Science, Technology and Environment, 3rd Floor, PHB Building, Anna Nagar, Pondicherry.
- 2 Additional Principal Chief Conservator of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (SEZ), 1st and 11nd Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai – 34.



(Lalit Bokolia)
Additional Director

ANNEXURE-II

COMPLIANCE TO TOR

COMPLIANCE TO TERMS OF REFERENCE (TOR)
TOR Vide F.N J-11011/32/2016-IA II (I) dt. 11.05.2016

Sr. No.	Compliance	Reply
1	Executive Summary	Executive Summary is attached.
2	Introduction	Presented in Chapter-1, Page No. C1-1
i	Details of the EIA Consultant including NABET accreditation	Refer Chapter-10
ii	Information about the project proponent	Presented in Sub-section-1.1.2 of Chapter-1, Page No.C1-1
iii	Importance and benefits of the project	- The use of Linear Alkyl Benzene Sulphonic Acid (LABSA) in the detergent manufacturing units have substantial demand in the country and has export potential also. - The proposed sulphonation plant will fulfill the demand for the LABSA directly and the demand of detergents indirectly. - The products of the proposed plant will also be exported, which will attract valuable Foreign Exchange.
3	Project Description	
i	Cost of project and time of completion	- The total cost for the proposed project is INR. 575 Lakhs. - The commissioning of the project will start after obtaining Environmental Clearance and CTO from MoEF&CC & State Pollution Control Committee respectively. - The project implementation schedule is shown in Table-2.4 of Chapter-2, Page No. C2-6.
ii	Products with capacities for the proposed project	- The proposed project is sulphonation of Linear Alkyl Benzene (LAB) to produce 72 TPD (18,000 TPA) of 96% Linear Alkyl Benzene Sulphonic Acid (LABSA). - The proposed process is based on the use of state of art SO₃ sulphonation technology using multi tube reactor.
iii	If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any	Not applicable
iv	List of raw materials required and their source along with mode of transportation	- The raw materials required are Organic alkylate and Sulphur. - The quantity, source along with mode of transportation and storage facility details are given in Table-2.2, Chapter-2, Page No.C2-4.

COMPLIANCE TO TERMS OF REFERENCE (TOR)
TOR Vide F.N J-11011/32/2016-IA II (I) dt. 11.05.2016

Sr. No.	Compliance	Reply
v	Other chemicals and materials required with quantities and storage capacities	- The other chemicals required is Caustic Soda lye of 50 TPA. - The caustic soda is stored in Stainless Steel tank.
vi	Details of Emission, effluents, hazardous waste generation and their management	- The stack emission details are given in Table-4.2 of Chapter-4, Page No. C4-6. - The air pollution & Odour control management details are provided in Sub-section-4.3.3.1 of Chapter-4, Page No.C4-9. - The sewage/effluent generation details are provided in Table-2.7 of Chapter-2, Page No. C2-17. - The entire effluent generation of 14.3 KLD will be treated in the proposed ETP and reused for cooling tower makeup and greenbelt maintenance. Furthermore, the brief details are provided in Section-2.9.2 of Chapter-2, Page No. C2-16. - The Solid waste generation and management details are given in Table-2.8 of Chapter-2, Page No. C2-17. Further, they are detailed in the Section-2.9.3 of Chapter-2, Page No. C2-17.
vii	Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)	<u>Water Requirement:</u> - The one time water requirement for the proposed project will be 48.5 KLD and the daily fresh water requirement will be 30.4 KLD. <u>Source:</u> The domestic requirement of 1.5 KLD will be met from PIPDIC and for the industrial process requirement, 28.9 KLD the water will be met from the authorized private Supplier. - The breakup of the estimated water requirement are given in Table-2.3 of Chapter-2, Page No. C2-6. - The Water balance diagram is shown in Figure-2.4 of Chapter-2, Page No. C2-7. <u>Power Requirement:</u> - The total power required for the proposed project is about 900 KVA, which will be met from the state grid. - To meet the emergency power requirement during the grid failure, diesel generator set having capacity of 1 x 1000 KVA has been proposed.

COMPLIANCE TO TERMS OF REFERENCE (TOR)
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		<u>Man-Power Requirement:</u> The total manpower required for the proposed project during the operation phase will be about 35 persons for direct activities and about 60 persons for indirect activities which would be mainly sourced from local community in and around the study area and few technical persons will be employed from outside area.
viii	Process description along with major equipments and machineries, process flow sheet (quantative) from raw material to products to be provided	- The major equipments/machineries proposed are Sulphur Melter- Burner, SO₃ Absorber System and Sulphonation System along with gas purifying machineries. - The Process description is presented in Section-2.8 of Chapter-2, Page No. C2-12. - The Process Flow Sheet is Presented in Figure-2.5 of Chapter-2, Page No. C2-14. and; - The Material Balance (quantitative) from raw material to products is Presented in Figure-2.6 of Chapter-2, Page No. C2-15.
ix	Hazard identification and details of proposed safety systems	Hazard identification and details of the safety system are provided in Section-7.3 of Chapter-7, Page No. C7-1.
x. Expansion / modernization proposals:		
	a. Copy of all the Environmental Clearance(s) including Amendments thereto obtained for the project from MoEF/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular dated 30 th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing/existing operation of the project from SPCB shall be attached with the EIA-EMP report	Not applicable
	b. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be	Not applicable

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	provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted																
4	Site Details																
i	Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered	- The proposed plant site is located in PIPDIC industrial estate of Sedarapet village, Villianur Commune Panchayat, Puducherry district, Puducherry. - The Location of the project is presented in Section-1.2.2 of Chapter-1, Page No. C1-2. - The proposed sulphonation plant will be developed in PIPDIC industrial estate which is notified as Special Economic Zone. No forest land and R & R issues are involved. Further, adequate land is available with PSPL. Hence, no alternative sites have been examined.															
ii	A toposheet of the study area of radius of 10 km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places.	The study area map prepared from toposheet is provided in Figure-1.2 of Chapter-1, Page No. C1-5.															
iii	Details w.r.t. option analysis for selection of site	The proposed sulphonation plant will be developed in PIPDIC industrial estate which is notified as Special Economic Zone. Further, adequate land is available with PSPL. Hence, no alternative sites have been examined.															
iv	Co-ordinates (lat-long) of all four corners of the site	<table border="1"> <thead> <tr> <th>Corner</th><th>Latitude</th><th>Longitude</th></tr> </thead> <tbody> <tr> <td>A</td><td>12° 00' 10.19"</td><td>79° 45' 19.21"</td></tr> <tr> <td>B</td><td>12° 00' 09.91"</td><td>79° 45' 21.72"</td></tr> <tr> <td>C</td><td>12° 00' 06.50"</td><td>79° 45' 20.63"</td></tr> <tr> <td>D</td><td>12° 00' 07.43"</td><td>79° 45' 18.07"</td></tr> </tbody> </table>	Corner	Latitude	Longitude	A	12° 00' 10.19"	79° 45' 19.21"	B	12° 00' 09.91"	79° 45' 21.72"	C	12° 00' 06.50"	79° 45' 20.63"	D	12° 00' 07.43"	79° 45' 18.07"
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v	Google Map-Earth downloaded of the project site	The Google Map-Earth downloaded of the proposed project site is presented in Figure-1.3 of Chapter-1, Page No. C1-6.															
vi	Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities ect. If located within an	- The Overall plant Layout of the proposed plant is presented in Figure-2.1 of Chapter-2, Page No. C2-2. - Layout map of the PIPDIC industrial estate															

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	Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate	highlighting the location of the proposed Sulphonation plant is Presented in Figure-2.3 of Chapter-2, Page No. C2-5.																																																																
vii	Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular	The Photographs of the proposed site are presented in Figure-1.4 of Chapter-1, Page No. C1-8.																																																																
viii	Landuse break-up of total land of the project site (identified and acquired), government/private– agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area)	The total land allotted for the proposed plant at PIPDIC, Sedarapet is 0.907 ha (2.24 acres). <table><tr><th>Sr. No.</th><th>Plant Facilities</th><th>Area (ha)</th><th>(%)</th></tr><tr><td>1.</td><td>Production facilities</td><td>0.234</td><td>25.80</td></tr><tr><td>2.</td><td>Storage Building & Tank farm</td><td>0.136</td><td>15.00</td></tr><tr><td>3.</td><td>Greenbelt development</td><td>0.250</td><td>27.56</td></tr><tr><td>4.</td><td>Open area</td><td>0.287</td><td>31.64</td></tr><tr><td colspan="2">Total</td><td>0.907</td><td>100.0</td></tr></table>	Sr. No.	Plant Facilities	Area (ha)	(%)	1.	Production facilities	0.234	25.80	2.	Storage Building & Tank farm	0.136	15.00	3.	Greenbelt development	0.250	27.56	4.	Open area	0.287	31.64	Total		0.907	100.0																																								
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ix	A list of major industries with name and type within study area (10 km radius) shall be incorporated. Land use details of the study area.	- The list of major industries located within the study area is attached as Annexure-X. - The landuse details of the study area based on Satellite data is shown in below table: <table><tr><th>Sr No.</th><th>Landuse</th><th>Area (Sq.Km)</th><th>(%)</th></tr><tr><td colspan="4">Built-up Land/Other Development</td></tr><tr><td>1</td><td>Settlements/ Airports/Mandir</td><td>39.564</td><td>12.6</td></tr><tr><td>2</td><td>Industrial Area</td><td>16.642</td><td>5.3</td></tr><tr><td colspan="4">Waste Land</td></tr><tr><td>3</td><td>Land with Scrub</td><td>12.246</td><td>3.9</td></tr><tr><td>4</td><td>Land without Scrub</td><td>4.396</td><td>1.4</td></tr><tr><td>5</td><td>Mud Quarry</td><td>0.942</td><td>0.3</td></tr><tr><td colspan="4">Water body</td></tr><tr><td>6</td><td>Tank/River</td><td>44.588</td><td>14.2</td></tr><tr><td colspan="4">Crop Land</td></tr><tr><td>7</td><td>Single Crop</td><td>124.03</td><td>39.5</td></tr><tr><td>8</td><td>Double Crop</td><td>32.028</td><td>10.2</td></tr><tr><td>9</td><td>Plantation</td><td>39.564</td><td>12.6</td></tr><tr><td colspan="2">Total</td><td>314</td><td>100.0</td></tr><tr><td colspan="4">Source: NRSC, Hyderabad, IRS Resourcesat-2 LISS IV-FX-29th December, 2015</td></tr></table>	Sr No.	Landuse	Area (Sq.Km)	(%)	Built-up Land/Other Development				1	Settlements/ Airports/Mandir	39.564	12.6	2	Industrial Area	16.642	5.3	Waste Land				3	Land with Scrub	12.246	3.9	4	Land without Scrub	4.396	1.4	5	Mud Quarry	0.942	0.3	Water body				6	Tank/River	44.588	14.2	Crop Land				7	Single Crop	124.03	39.5	8	Double Crop	32.028	10.2	9	Plantation	39.564	12.6	Total		314	100.0	Source: NRSC, Hyderabad, IRS Resourcesat-2 LISS IV-FX-29 th December, 2015			
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x	Geological features and Geo-hydrological status of the study area shall be included.	- The Geological features are Presented in Sub-Section-3.2.2 of Chapter-3, Page No. C3-1. - The Geo-hydrological status of the study area are Presented in Sub-Section-3.2.5 of Chapter-3, Page No.C3-4.																																																																

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xi	Details of Drainage of the project upto 5 km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (mega green field projects)	The details of drainage are Presented in Sub-Section-3.2.4 and Figure-3.2 of Chapter-3, Page No.C3-2.
xii	Status of aquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land	The proposed project does not involve any land aquisition, as the entire land required for the proposed project is available under Power Soaps Private Limited.
xiii	R & R details in respect of land in line with state Government policy	The proposed project does not involve any Rehabilitation & Resettlement issues, as the entire land required for the proposed project is available under PSPL.
5	Forest and wildlife related issues (if applicable):	
i	Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable)	No forest land is involved in the proposed project. Hence it is not applicable.
ii	Landuse map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (in case of projects involving forest land more than 40 ha)	The Satellite imagery and Landuse map of the study area are presented in Figure-3.16 and Figure-3.17 of Chapter-3, Page No. C3-47 and C3-48 respectively.
iii	Status of application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted	The Status of application submitted for obtaining the stage I forestry clearance is in under Progress.
iv	The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map dully authenticated by Chief Wildlife Warden showing these features vis-a-vis the poject location and the recommendations or comments of the Chief Wildlife Warden-thereon	It is under Progress
v	Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area	It is under Progress

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vi	Copy of application submitted for clearance under the Wildlife Act, 1972, to the Standing Committee of the National Board for Wildlife	It is under Progress
6	Environmental Status	
i	Determination of atmosphere inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall	Presented in Sub-Section-3.3.1 of Chapter-3, Page No. C3-7.
ii	AAQ data (except monsoon) at 8 locations for PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests	- The AAQ results collected are presented in Table-3.8 (a) and Table-3.8 (b) of Chapter-3, Page No. C3-21. - The AAQ monitoring locations are carried out based on Figure-3.11 of Chapter-3, Page No. C3-18.
iii	Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAAQM Notification of Nov. 2009 along with - min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report	The raw data of all AAQ measurements are presented in Annexure-V.
iv	Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEF & CC guidelines	The Surface water quality are presented in Table-3.11 of Chapter-3, Page No. C3-27.
v	Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF & CC, if yes give details	Not applicable
vi	Ground water monitoring at minimum at 8 locations shall be included	The ground water quality are Presented in Table-3.10(a) and Table-3.10(b) of Chapter -3, Page No. C3-25 and C3-26.
vii	Noise levels monitoring at 8 locations within the study area	The details are Presented in Table-3.16 of Chapter-3, Page No. C3-34.
viii	Soil Characteristic as per CPCB guidelines	The details are Presented in Table-3.13 of Chapter-3, Page No. C3-31.
ix	Traffic study of the area, types of vehicles, frequency of vehicles for transportation of materials, additional	The traffic study details are presented in Section-7.10 of Chapter-7, Page No. C7-24.

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	traffic due to proposed project, parking arrangement etc	
x	Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule - I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished	- The Flora and Fauna details are attached as Annexure-VI and Annexure-VII respectively. - Wildlife Conservation Plan is in under Progress
xi	Socio-economic status of the study area	The Socio-economic status of the study area are Presented in Section-3.10 of Chapter-3, Page No. C3-49.
7	Impact and Environment Management Plan	
i	Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modeling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any	- The Ground level concentration of pollutants after the proposed project are presented in Table-4.4 of Chapter-4, Page No. C4-9. - Details of the model used and inputs provided are provided in Chapter-4, Pg. No. C4-5 to C4-9. - The air quality contour is presented in Figure-4.1 of Chapter-4, page No. C4-8.
ii	Water Quality modelling -in case of discharge in water body	There is no proposal for the discharge of effluent in to the local drain. Hence Water Quality Modelling is not required.
iii	Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined	- The impact of the traffic to the transport condition are presented in Sub-Section-7.10.2 of Chapter-7, Page No. C7-26. - The raw materials are carried through closed trucks so there will not be a impact to the surroundings. Moreover the industry is located within the industrial estate.
iv	A note on treatment of wastewater from different plant operations, extent recycled and reused for different	The quantum of effluent generation from the various processes will be 14.3 KDL. The effluent generated will be treated in the

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	purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules	proposed ETP and then reused for cooling tower make up (12.0 KLD) and greenbelt maintenance (2.3 KLD). - Wastewater generated from the domestic activities will be about 1.4 KLD and treated in septic tank followed by dispersion trench. The Condensate return (6.1 KLD) from the boiler after evaporation and steam loss will be recirculated for the demineralization plant, until there is any source of contamination or dissolved solids contained within the system. - The scheme of effluent treatment is presented in Figure-9.3 of Chapter-9, Page No. C9-9. - The Characteristics of effluent are shown in Table-9.2 and Table-9.3 of Chapter-9, Page No. C9-7.
v	Details of stack emission and action plan for control of emissions to meet standards	- Details of the anticipated stack emissions are presented in Table-4.2 of Chapter-4, Page No. C4-6. - Action plan to meet standards are presented in Sub-Section-9.3.1 of Chapter-9, Page No. C9-3.
vi	Measures for fugitive emission control	Action plan to meet standards for fugitive emission are presented in Sub-Section-4.2.2 of Chapter-4, Page No. C4-2.
vii	Details of hazardous waste generation and their storage, utilization and disposal. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation and natural resource conservation	- The details of the solid waste generation and their method of disposal are presented in Table-2.8 of Chapter-2, Pg.No.C2-17. - The copies of the same are in under progress. - To implement the concept of waste-minimization, recycle/ reuse /recover techniques, the spent catalyst generated during annual shutdown will be given back to the manufacturer for recycling the same and again used for the industrial process.
viii	Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.	No fly ash will be generated from the proposed sulphonation plant.
ix	Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc.,	The details are Presented in Section-9.4 of Chapter-9, Page No. C9-11.

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	Shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.	
x	Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources	The action plan for rainwater harvesting are provided in Section-9.5 of Chapter-9, Page No. C9-14.
xi	Total capital cost and recurring cost/annum for environmental pollution control measures shall be included	The total capital and recurring cost are presented in Table-9.6 of Chapter-9, Page No. C9-19.
xii	Action plan for post-project environmental monitoring shall be submitted	The details are Presented in Table-6.3 of Chapter-6, Page No. C6-3.
xiii	Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.	- Onsite and Offsite Emergency Management Plan are presented in Sub-Section-7.6.3 and 7.6.4 of Chapter-7, Page No. C7-9 and C7-15 respectively. - Disaster management plan is Presented in Section-7.6 of Chapter-7, Page No. C7-8.
8 Occupational health		
i	Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers	The proposed occupational health measures are given in Section-7.7 of Chapter-7, Page No. C7-18.
ii	Details of exposure specific health status evaluation of worker. If the worker's health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.	
iii	Details of existing Occupational & Safety Hazards. What are the exposure	

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	levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved.	
iv	Annual report of health status of workers with special reference to Occupational Health and Safety	The annual report of health status of workers will be carried out regularly during the operational phase of the project.
9	Corporate Environment Policy	
i	Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report	The company doesn't have a corporate environment policy.
ii	Does the Environment Policy prescribe for standard operating process/procedures to bring into focus any infringement/deviation/violation of the environmental of forest norms/conditions? If so, it may be detailed in the EIA.	Not Applicable
iii	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given	The hierarchial system or administrative order of the company are presented in Section-9.6 of Chapter-9, Page No. C9-17.
iv	Does the company have system of reporting of non compliances/violations of environmental norms to the Board of Directors of the company and/or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report	Not Applicable
10	Details regarding infrastructure facilities such sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase	Details are presented in Sub-Section-9.2.9 of Chapter-9, Pg. No. C9-3.
11	Enterprise Social Commitment (ESC)	
	i. Adequate funds (at least 2.5% of the project cost) shall be earmarked towards the Enterprise Social	Public Hearing is to be conducted.

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	Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon	
12	Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case	Nil
13	A tabular chart with index for point wise compliance of above TOR	Complied.
14	The TORs prescribed shall be valid for a period of three years for submission of the EIA-EMP reports along with Public Hearing Proceedings (wherever stipulated)	Complied.
	The following general points shall be noted:	
i	All documents shall be properly indexed, page numbered	
ii	Period/date of data collection shall be clearly indicated	
iii	Authenticated English translation of all material in Regional languages shall be provided	
iv	The letter/application for environmental clearance shall quote the MoEF file No. and also attach a copy of the letter	
v	The copy of the letter received from the Ministry shall be also attached as an annexure to the final EIA-EMP report	
vi	The index of the final EIA-EMP report must indicate the specific chapter and page no. of the EIA-EMP report	
vii	While preparing the EIA report, the	

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	instructions for the proponents and instructions for the consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) vii. While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4 th August, 2009, which are available on the website of this Ministry shall also be followed	
viii	viii. The consultants involved in the preparation of Council of India (QCI)/National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA-EMP reports prepared by them and data provided by other organization/Laboratories including their status of approvals etc. Name of the Consultant and the Accreditation details shall be posted on the EIA-EMP report as well as on the cover of the Hard Copy of the Presentation material for EC presentation	• Provided in Disclosure of Consultant of Chapter-11.
ix	ix. TORs prescribed by the Expert Appraisal Committee (industry) shall be considered for preparation of EIA-EMP report for the project in addition to all the relevant information as per the Generic Structure of EIA given in Appendix III and IIIA in the EIA Notification, 2006. Where the documents provided are in a language other than English, an English translation shall be provided. The draft EIA-EMP report shall be submitted to the State Pollution Control Board of the concerned EIA-EMP report shall be submitted to the State Pollution Control Board of the concerned State for conduct of Public Hearing. The SPCB shall conduct the Public Hearing/public consultation, district-wise, as per the provisions of EIA notification, 2006. The Public Hearing shall be chaired by an Officer not below the rank of Additional District Magistrate. The issues raised in the	• Attached as Annexure-I.

COMPLIANCE TO TERMS OF REFERENCE (TOR)
TOR Vide F.N J-11011/32/2016-IA II (I) dt. 11.05.2016

Sr. No.	Compliance	Reply
	Public Hearing and during the consultation process and the commitments made by the project proponent on the same shall be included separately in EIA-EMP report in a separate chapter and summarised in a tabular chart with financial budget (capital and revenue) along with time-schedule of implementation for complying with the commitments made. The final EIA report shall be submitted to the Ministry for obtaining environmental clearance	
A.	Specific TOR	
1	Details on solvents to be used, measures for solvent recovery and for emissions control	No Solvents will be used for the Process.
2	Details of process emissions from the proposed unit and its arrangement to control	The details of process emission are presented in Table-4.2 of Chapter-4, Page No, C4-6 and its arrangements to control are presented in Sub-section-4.3.3.1 of Chapter-4, Page No. C4-9.
3	Ambient air quality data should include VOC, etc.,	The AAQ data including VOC and others are presented in Sub-section-3.4.5.1 of Chapter-3, Page No. C3-22.
4	Work zone monitoring arrangements for hazardous chemicals	The proposed project does not involve handling of any hazardous chemicals. Also, the raw materials used for the process and finished goods are not hazardous.
5	Detailed effluent treatment scheme including segregation of effluent streams for units adopting Zero liquid discharge	- The details of effluent treatment scheme are presented in Sub-Section-9.3.2.1 of Chapter-9, Page No. C9-8. - Effluent treatment scheme is shown in Figure-9.3 of Chapter-9, Page No. C9-9.
6	Action Plan for odour control to be submitted	The odour control measures are presented in Sub-Section-4.3.3.1 of Chapter-4, Page No. C4-9.
7	Details of Incinerator alongwith pollution control device to be provided	- No Incinerator will be required for the proposed project. - The details of pollution control devices are presented in Sub-Section-9.3.1 of Chapter-9, Page No. C9-3.
8	A copy of the Memorandum of Understanding signed with cement manufacturers indicating clearly that they co-process organic solid/hazardous waste generated	Not Applicable

COMPLIANCE TO TERMS OF REFERENCE (TOR)
TOR Vide F.N J-11011/32/2016-IA II (I) dt. 11.05.2016

Sr. No.	Compliance	Reply
9	Authorization/Membership for the disposal of liquid effluent in CETP and solid/hazardous waste in TSDF, if any	There is no proposal for CETP in the proposed plant. Hence, not applicable.
10	Material Safety Data Sheet for all the Chemicals are being used/will be used	The MSDS are attached as Annexure-XI.
11	Authorization/Membership for the disposal of solid/hazardous waste in TSDF are being used/will be used	It is under Progress
12	Authorization/Membership for the disposal of solid/hazardous waste in TSDF	It is under Progress
13	Risk assessment for storage and handling of hazardous chemicals/solvents. Action plan for handling & safety system to be incorporated	The proposed project does not involve storage and handling of any hazardous chemicals/solvents.
14	Arrangements for ensuring health and safety of workers engaged in handling of toxic materials	The proposed project does not involve handling of any toxic materials. Also, the raw materials used for the process and finished goods are non toxic.
B.	Additional TOR	
i.	Public hearing to be conducted and issues raised and commitments made by the project proponent on the same should be included in EIA/EMP Report in the form of tabular chart with financial budget for complying with the commitments made.	Public Hearing is to be conducted.
ii.	A copy of application submitted to NBWL seeking wildlife clearance due to Ousudu Bird Sanctuary	It is under Progress

ANNEXURE-III

APPLICABLE ENVIRONMENTAL STANDARDS

ANNEXURE-III
APPLICABLE ENVIRONMENTAL STANDARDS

1.0 Revised Ambient Air Quality Standards (Dated 16th November, 2009)

The revised NAAQ standards issued on 16th November, 2009 are given in **Table-1**.

TABLE-1
REVISED NATIONAL AMBIENT AIR QUALITY STANDARDS
(Dated 16th November, 2009)

Pollutant	Time Weighted Average	Concentration in Ambient Air ($\mu\text{g}/\text{m}^3$)	
		Industrial Residential, Rural & Other Areas	Ecologically Sensitive Areas (notified by Central Government)
Sulphur dioxide (SO_2) ($\mu\text{g}/\text{m}^3$)	Annual Average*	50	20
	24 Hours**	80	80
Nitrogen dioxide (NO_2) ($\mu\text{g}/\text{m}^3$)	Annual Average*	40	30
	24 Hours**	80	80
Particulate Matter (Size less than 10 μg) (PM_{10}) ($\mu\text{g}/\text{m}^3$)	Annual Average*	60	60
	24 Hours**	100	100
Particulate Matter (Size less than 2.5 μg) ($\text{PM}_{2.5}$) ($\mu\text{g}/\text{m}^3$)	Annual Average*	40	40
	24 Hours**	60	60
Ozone (O_3) ($\mu\text{g}/\text{m}^3$)	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb) ($\mu\text{g}/\text{m}^3$)	Annual Average*	0.5	0.5
	24 Hours**	1.5	1.0
Carbon monoxide (CO) ($\mu\text{g}/\text{m}^3$)	8 Hours**	2000	2000
	1 Hour**	4000	4000
Ammonia (NH_3) ($\mu\text{g}/\text{m}^3$)	Annual Average*	100	100
	24 Hours**	400	400
Benzene (C_6H_6)	Annual*	5	5
Benzo(a) Pyrene (BaP)- particulate phase only ($\mu\text{g}/\text{m}^3$)	Annual*	0.001	0.001
Arsenic (As) ($\mu\text{g}/\text{m}^3$)	Annual*	0.006	0.006
Nickel (Ni) ($\mu\text{g}/\text{m}^3$)	Annual*	0.020	0.020

Note:

*Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform interval.

**24 hourly/8 hourly/1 hourly monitored values, as applicable, should be met 98% of the time in a year. However 2% of the time, it may exceed but not on two consecutive days of monitoring.

2.0 Ambient Air Quality Standards (Dated 11th April 1994)

National Ambient Air Quality (NAAQ) Standards for ambient air prescribed by Central Pollution Control Board vide Gazette Notification dated 11th April, 1994 are given below in **Table-2**.

ANNEXURE-III
APPLICABLE ENVIRONMENTAL STANDARDS

TABLE-2
NATIONAL AMBIENT AIR QUALITY STANDARDS (Dated 11th April 1994)

Pollutant	Time Weighted Average	Concentration in Ambient Air ($\mu\text{g}/\text{m}^3$)		
		Industrial Area	Residential, Rural & Other Areas	Sensitive Areas
Sulphur dioxide (SO_2) ($\mu\text{g}/\text{m}^3$)	Annual Average*	80	60	15
	24 Hours**	120	80	30
Oxides of Nitrogen (NO_x) ($\mu\text{g}/\text{m}^3$)	Annual Average*	80	60	15
	24 Hours**	120	80	30
Suspended Particulate Matter (SPM) ($\mu\text{g}/\text{m}^3$)	Annual Average*	360	140	70
	24 Hours**	500	200	100
Respirable Particulate Matter (Size less than 10 microns) ($\mu\text{g}/\text{m}^3$)	Annual Average*	120	60	50
	24 Hours**	150	100	75
Lead (Pb) ($\mu\text{g}/\text{m}^3$)	Annual Average*	1.0	0.75	0.50
	24 Hours**	1.5	1.0	0.75
Carbon monoxide (CO) ($\mu\text{g}/\text{m}^3$)	8 Hours	5000	2000	1000
	1 Hour**	10000	4000	2000

Note:

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However 2% of the time, it may exceed but not on two consecutive days.

3.0 Noise Limits and Guidelines for Diesel Generators

- Noise from DG set shall be controlled by providing an acoustic enclosure or by treating the room acoustically, at the users end;
- The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction upto actual ambient noise level, preferably, in the nighttime). The measurement for Insertion Loss may be done at different points at 0.5 m from the acoustic enclosure/room, and then averaged;
- These limits shall be regulated by the State Pollution Control Boards and the State Pollution Control Committees;
- The manufacturer shall offer to the user a standard acoustic enclosure of 25 dB (A) insertion loss and also a suitable exhaust muffler with insertion loss of 25 dB (A);
- The user shall make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper siting and control measures;
- Installation of a DG set must be strictly in compliance with the recommendations of the DG set manufacturer; and
- A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

ANNEXURE-III
APPLICABLE ENVIRONMENTAL STANDARDS

4.0 Ambient Noise Standards

Ambient standards with respect to noise have been notified by the Ministry of Environment and Forests vide gazette notification dated 26th December 1989 (amended in February, 2000). It is based on the 'A' weighted equivalent noise level (L_{eq}). The ambient noise standards are presented in **Table-2**.

TABLE-2
AMBIENT NOISE STANDARDS

Area Code	Category of Area	Noise Levels dB(A) Leq	
		Day time*	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone**	50	40

Note:

* Daytime is from 7 am to 10 pm.

** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.

5.0 Noise Standards for Occupational Exposure

Noise standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA) which are being enforced by Government of India through model rules framed under Factories Act. These are given in **Table-3** below.

TABLE-3
STANDARDS FOR OCCUPATIONAL EXPOSURE

Total Time of Exposure per Day in Hours (Continuous or Short term Exposure)	Sound Pressure Level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105
3/4	107
1/2	110
1/4	115
Never	>115

Note:

1. No exposure in excess of 115 dB(A) is to be permitted.
2. For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column (1), the permissible level is to be determined by extrapolation on a proportionate scale.

ANNEXURE-III
APPLICABLE ENVIRONMENTAL STANDARDS

6.0 Wastewater Discharge Standards

The wastewater discharge standards for “discharge on land for irrigation” are stipulated under the Environment Protection Rules (1993) and are given below in **Table-4**.

TABLE-4
WASTE WATER DISCHARGE STANDARDS

Sr. No.	List of Parameters	Units	Standard (On Land Irrigation)
1	Color and Odor	--	All efforts should be made to remove color and unpleasant odor as far as practicable.
2	Suspended Solids	Mg/l	200
3	Particle size of Suspended Solids	--	Shall pass 850 micron IS sieve.
4	pH value	--	5.5 to 9.0
5	Temperature	°C	Not specified.
6	Oil and grease, Max.	mg/l	10.0
7	Total residual chlorine, Max.	mg/l	Not specified
8	Ammonical nitrogen (as N), Max.	mg/l	Not specified
9	Total Kjeldhal nitrogen (as N),Max	mg/l	Not specified
10	Free ammonia (as NH ₃), Max.	mg/l	Not specified
11	Biochemical oxygen demand (3 days at 27°C), Max.	mg/l	100.0
12	Chemical oxygen demand, Max.	mg/l	Not specified
13	Arsenic (as As), Max.	mg/l	0.2
14	Mercury (as Hg), Max.	mg/l	Not specified
15	Lead (as Pb), Max.	mg/l	Not specified
16	Cadmium (as Cd), Max.	mg/l	Not specified
17	Hexavalent chromium (as Cr ⁺⁶), Max.	mg/l	Not specified
18	Total chromium (as Cr), Max.	mg/l	Not specified
19	Copper (as Cu), Max.	mg/l	Not specified
20	Zinc (as Zn), Max.	mg/l	Not specified
21	Selenium (as Se), Max.	mg/l	Not specified
22	Nickel (as Ni), Max.	mg/l	Not specified
23	Cyanide (as CN), Max.	mg/l	0.2
24	Fluorides as F	mg/l	Not specified
25	Dissolved phosphates (as P),Max	mg/l	Not Specified
26	Sulphides as (S), Max.	mg/l	Not specified
27	Phenolic compounds (as C ₂ H ₅ OH), Max.	mg/l	Not specified
28	Radioactive Materials		
a]	Alpha Emitters, Max.	mC/ml	10 ⁻⁷
b]	Beta Emitters, Max.	mC/ml	10 ⁻⁷
29	Bio-assay test	--	90% survival of fish after 96 hours in 100% effluent.
30	Manganese (as Mn)	mg/l	Not specified
31	Iron (as Fe)	mg/l	Not specified
32	Vanadium (as V)	mg/l	Not specified
33	Nitrate nitrogen	mg/l	Not specified

Note: These standards shall be applicable for industries, operations or processes other than those industries, operations or process for which standards have been specified in Schedule of the Environment Protection Rules, 1989.

ANNEXURE-IV

METHODOLOGY ADOPTED FOR SAMPLING AND ANALYSIS

ANNEXURE-IV
METHODOLOGY ADOPTED FOR SAMPLING AND ANALYSIS

1.0 Meteorology

The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards (IS:8829) and India Meteorological Department (IMD).

1.1 Methodology of Data Generation

The Central Monitoring Station (CMS) equipped with continuous monitoring equipment was installed at site at a height of about 10 m above ground level to record wind speed, direction, relative humidity and temperature. The meteorological monitoring station was located in such a way that it is free from any obstructions and as per the guidelines specified under IS:8829. Cloud cover was recorded by visual observation. Rainfall was monitored by rain gauge.

The continuous recording meteorological instrument of Dynalab, Pune (Model No.WDL1002) has been used for recording the met data. The sensitivity of the equipment is as given in **Table-1**.

TABLE-1
SENSITIVITY OF METEOROLOGY MONITORING STATION

Sr. No.	Sensor	Sensitivity
1	Wind speed Sensor	± 0.02 m/s
2	Wind direction Sensor	± 3 degrees
3	Temperature Sensor	± 0.2°C

Hourly maximum, minimum and average values of wind speed, direction and temperature were recorded continuously with continuous monitoring equipment. All the sensors were connected to filter and then logged on to datalogger. The readings were recorded in a memory module, which was attached to datalogger. The memory module was downloaded in computer through Dynalab software. The storage capacity of memory module was 256 KB. Data was downloaded every fortnight into the computer. The data was recorded continuously. The recovery of data was about 98%. The rest of 2 % data gaps were filled by referring to IMD data and daily weather reports in the local newspapers. However, Relative Humidity and Rainfall were recorded manually.

1.2 Ambient Air Quality

The air samples were analyzed as per standard methods specified by Central Pollution Control Board (CPCB), IS: 5184 and American Public Health Association (APHA).

The techniques used for ambient air quality monitoring and minimum detectable level are given in **Table-3**.

ANNEXURE-IV
METHODOLOGY ADOPTED FOR SAMPLING AND ANALYSIS

TABLE-3
TECHNIQUES USED FOR AMBIENT AIR QUALITY MONITORING

Parameters	Test Method [as per GSR 826(E), Sch-VII]	Minimum Detectable Limit ($\mu\text{g}/\text{m}^3$)
Particulate Matter, PM10	Gravimetric Method	1.0
Particulate Matter, PM2.5	Gravimetric Method	1.0
Sulphur dioxide (SO_2)	Improved West and Gaeke Method	4.0
Nitrogen dioxide (NO_x)	Modified Jacob and Hochheiser Method	4.0
Carbon Monoxide (CO) (3 x 8 hr)	Gas Monitor	12.5
Ozone (O_3) (3 x 8 hr)	Spectroscopic analysis	0.01 ppm /20 $\mu\text{g}/\text{m}^3$
Ammonia, NH_3	Indophenol Blue method	4.0
Benzene, C_6H_6	Solvent extraction followed by GC analysis	0.001
Benzo(a)pyrene in Particulate phase	Solvent extraction followed by GC analysis	0.0001
Heavy metals in particulate phase for Arsenic (As), Nickel (Ni), Lead (Pb)	AAS/ICP method	0.0001

1.3 Water Analysis

Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1 ml HNO_3 . Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality status in the study area. Parameters like temperature, Dissolved Oxygen (DO) and pH were analyzed at the time of sample collection.

The methodology for sample collection and preservation techniques was followed as per the Standard Operating Procedures (SOP) mentioned in **Table-4**.

TABLE-4
STANDARD OPERATING PROCEDURES (SOP)
FOR WATER AND WASTEWATER SAMPLING

Parameter	Sample Collection	Sample Size	Storage/ Preservation
pH	Grab sampling Plastic /glass container	50 ml	On site analysis
Electrical Conductivity	Grab sampling Plastic /glass container	50 ml	On site parameter
Total suspended solids	Grab sampling Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
Total Dissolved Solids	Grab sampling Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
BOD	Grab sampling	500 ml	Refrigeration, 48 hrs

ANNEXURE-IV
METHODOLOGY ADOPTED FOR SAMPLING AND ANALYSIS

Parameter	Sample Collection	Sample Size	Storage/ Preservation
	Plastic /glass container		
Hardness	Grab sampling Plastic /glass container	100 ml	Add HNO ₃ to pH<2, refrigeration; 6 months
Chlorides	Grab sampling Plastic /glass container	50 ml	Not required; 28 days
Sulphates	Grab sampling Plastic /glass container	100 ml	Refrigeration; 28 days
Sodium, Potassium	Plastic container	100 ml	Not required; 6 months
Nitrates	Plastic containers	100 ml	Refrigeration; 48 hrs
Fluorides	Plastic containers only	100 ml	Not required; 28 days
Alkalinity	Plastic/ glass containers	100 ml	Refrigeration; 14 days
Ammonia	Plastic/ glass containers	100 ml	Add H ₂ SO ₄ to pH>2, refrigeration, 28 days
Hexavalent Chromium, Cr ⁺⁶	Plastic/ Glass rinse with 1+1 HNO ₃	100 ml	Grab sample; refrigeration; 24 hrs
Heavy Metals (Hg, Cd, Cr, Cu, Fe, Zn, Pb etc.)	Plastic/ Glass rinse with 1+1 HNO ₃	500 ml	Filter, add HNO ₃ to pH>2; Grab sample; 6 months

Source: Standard Methods for the Examination of Water and Wastewater, Published By APHA, AWWA, WEF 19th Edition, 1995

1.3.1 Analytical Techniques

The analytical techniques used for water and wastewater analysis is given in the **Table-5**.

TABLE-5
ANALYTICAL TECHNIQUES
FOR WATER AND WASTEWATER ANALYSIS

Parameter	Method
pH	APHA-4500-H ⁺
Colour	APHA-2120 C
Odour	IS: 3025, Part-4
Temperature	APHA-2550 B
Dissolved Oxygen	APHA-4500 O
BOD	APHA-5210 B
Electrical conductivity	APHA-2510 B
Turbidity	APHA-2130 B
Chlorides	APHA-4500 Cl ⁻
Fluorides	APHA-4500 F ⁻
Total dissolved solids	APHA-2540 C
Total suspended solids	APHA-2540 D
Total hardness	APHA-2340 C
Sulphates	APHA-4500 SO ₄ ⁻²
Arsenic	APHA-3120 B/ APHA-3114 B/ APHA-3500 As
Calcium	APHA-3120 B/ APHA-3500 Ca
Magnesium	APHA-3120 B/ APHA-3500 Mg
Sodium	APHA-3120 B/ APHA-3500 Na

ANNEXURE-IV
METHODOLOGY ADOPTED FOR SAMPLING AND ANALYSIS

Parameter	Method
Potassium	APHA-3120 B/ APHA-3500 K
Manganese	APHA-3120 B/ APHA-3500 Mn
Mercury	APHA-3112 B/ APHA-3500 Hg
Selenium	APHA-3120 B/ APHA-3114 B/ APHA-3500 Se
Lead	APHA-3120 B/ APHA-3500 Pb
Copper	APHA-3120 B/ APHA-3500 Cu
Cadmium	APHA-3120 B/ APHA-3500 Cd
Iron	APHA-3120 B/ APHA-3500 Fe
Zinc	APHA-3120 B/ APHA-3500 Zn
Boron	APHA-4500 B
Coliform organisms	APHA-9215 D
Alkalinity	APHA-2320 B

1.4 Soil Quality

At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and are homogenized. This is in line with IS: 2720 & Methods of Soil Analysis, Part-1, 2nd edition, 1986 of (American Society for Agronomy and Soil Science Society of America). The homogenized samples were analyzed for physical and chemical characteristics. The soil samples were collected and analyzed once in each season.

The samples have been analyzed as per the established scientific methods for physico-chemical parameters. The heavy metals have been analyzed by using Atomic Absorption Spectrophotometer and Inductive Coupled Plasma Analyzer.

The methodology adopted for each parameter is described in **Table-6**.

TABLE-6
ANALYTICAL TECHNIQUES FOR SOIL ANALYSIS

Parameter	Method (ASTM number)
Grain size distribution	Sieve analysis (D 422 – 63)
Textural classification	Chart developed by Public Roads Administration
Infiltration capacity	Infiltrometer
Bulk density	Sand replacement, core cutter
Porosity	Void ratio
Sodium absorption ratio	Flame colourimetric (D 1428-82)
PH	pH meter (D 1293-84)
Electrical conductivity	Conductivity meter (D 1125-82)
Nitrogen	Kjeldahl distillation (D 3590-84)
Phosphorus	Molybdenum blue, colourimetric (D 515-82)
Potassium	Flame photometric (D 1428-82)
Copper	AAS (D 1688-84)
Iron	AAS (D 1068-84)
Zinc	AAS (D 1691-84)
Boron	Surcumin, colourimetric (D 3082-79)
Chlorides	Argentometric (D 512-81 Rev 85)
Fluorides	Fusion followed by distillation and estimation by Ion selective electrode.

ANNEXURE-IV
METHODOLOGY ADOPTED FOR SAMPLING AND ANALYSIS

1.5 Noise Levels

1.5.1 Method of Monitoring

Noise level monitoring was carried out continuously for 24-hours with one hour interval starting at 0030 hrs to 0030 hrs next day. The noise levels were monitored on working days only and Saturdays, Sundays and public holidays were not monitored. During each hour L_{eq} were directly computed by the instrument based on the sound pressure levels. L_{day} (L_d), L_{night} (L_n) and L_{dn} values were computed using corresponding hourly L_{eq} of day and night respectively. Monitoring was carried out at 'A' response and fast mode.

Parameters Measured During Monitoring

For noise levels measured over a given period of time interval, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time certain noise levels exceeds the time interval. The notation for the statistical quantities of noise levels is described below:

- Hourly L_{eq} values have been computed by integrating sound level meter.
- L_{day} : As per the CPCB guidelines the day time limit is between 07:00 hours to 22.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.
- L_{night} : As per the CPCB guidelines the night time limit is between 22:00 hours to 07.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.

A rating developed by Environmental Protection Agency, (US-EPA) for specification of community noise from all the sources is the Day-Night Sound Level, (L_{dn}).

L_{dn} : It is similar to a 24 hr equivalent sound level except that during night time period (10 PM to 07 AM) a 10 dB (A) weighting penalty is added to the instantaneous sound level before computing the 24 hr average. This nighttime penalty is added to account for the fact that noise during night when people usually sleep is judged as more annoying than the same noise during the daytime.

The L_{dn} for a given location in a community may be calculated from the hourly L_{eq} 's, by the following equation.

$$L_{dn} = 10 \log \frac{[\sum_{i=1}^{15} 10^{(L_{eq}i/10)} + \sum_{i=1}^9 10^{(L_{eq}i+10/10)}]}{24}$$

ANNEXURE- V

AMBIENT AIR QUALITY RESULTS

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-1							
Location : Project site (AAQ1)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
03.03.14	71.8	25.5	12.4	17.9	416	404	393
04.03.14	69.2	24.1	12.1	17.2	411	396	387
10.03.14	68.9	25.1	12.7	17.6	402	395	389
11.03.14	70.2	25.6	13.1	18.1	422	411	398
17.03.14	65.6	25.9	12.8	17.9	400	395	387
18.03.14	75.1	25.4	12.1	14.1	404	393	389
24.03.14	75.7	25.1	11.1	18.6	438	431	418
25.03.14	69.5	24.7	12.8	19.5	451	436	411
01.04.14	68.9	25.6	12.5	18.1	446	433	418
02.04.14	69.2	26.0	12.9	17.3	455	429	416
07.04.14	68.5	24.7	13.1	18.8	416	404	399
08.04.14	65.6	25.7	13.1	19.8	471	461	452
14.04.14	76.4	24.6	12.9	19.2	444	431	416
15.04.14	75.4	23.2	13.0	19.7	454	435	427
21.04.14	66.3	23.9	13.2	19.7	444	435	427
22.04.14	70.2	24.6	12.8	19.0	473	461	450
28.04.14	70.5	25.8	11.9	19.4	454	437	423
29.04.14	71.1	25.9	13.0	20.0	469	455	435
05.05.14	65.3	24.8	11.9	18.5	501	486	471
06.05.14	75.1	25.1	12.5	20.0	459	448	435
12.05.14	70.5	24.2	12.3	20.0	570	503	486
13.05.14	75.4	25.4	13.4	20.0	484	473	463
19.05.14	71.8	25.8	12.7	20.0	491	473	461
20.05.14	69.8	25.6	12.0	17.5	503	495	478
26.05.14	74.1	24.5	13.0	18.1	488	474	459
27.05.14	74.4	24.2	12.5	19.4	507	501	488
Maximum	76.4	26.0	13.4	20.0	570		
Minimum	65.3	23.2	11.1	14.1	387		
Average	70.9	25.0	12.4	16.0	479		
98 %tile	76.0	25.9	13.3	18.0	567		
All the values are expressed as µg/m ³							

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-2							
Location : Puliapallam (AAQ2)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
07.03.14	53.1	12.1	11.5	19.2	515	497	473
08.03.14	57.0	11.6	12.6	19.4	492	476	468
14.03.14	64.0	15.8	11.9	19.0	515	499	494
15.03.14	59.2	15.5	12.3	19.7	533	523	515
21.03.14	62.3	14.6	13.1	19.6	568	548	538
22.03.14	64.2	16.0	13.0	18.0	560	554	533
28.03.14	63.7	11.6	12.6	18.9	554	538	523
29.03.14	63.6	14.4	12.9	19.0	538	520	505
11.04.14	61.9	14.4	12.6	19.2	535	530	514
12.04.14	64.0	16.1	12.1	19.7	547	540	522
18.04.14	60.1	11.9	13.3	19.7	537	509	487
19.04.14	63.3	16.0	13.3	19.4	547	532	536
25.04.14	59.4	15.3	10.5	19.2	552	542	520
26.04.14	63.3	14.4	13.1	19.7	566	525	509
23.04.14	63.0	14.8	12.5	19.2	527	509	492
24.04.14	61.8	15.3	12.8	19.4	499	489	474
03.05.14	64.7	15.5	12.8	19.4	509	494	482
04.05.14	48.3	11.6	12.6	19.2	504	487	464
09.05.14	62.3	15.3	13.1	19.0	482	466	459
10.05.14	56.7	15.5	12.3	19.2	504	489	484
16.05.14	63.7	12.7	12.4	18.3	522	512	504
17.05.14	64.0	15.7	12.5	19.5	550	556	527
23.05.14	63.3	14.1	12.8	18.0	552	542	522
24.05.14	64.7	13.2	13.1	14.5	562	527	512
30.05.14	61.1	15.2	12.3	17.7	527	509	494
31.05.14	60.6	12.7	12.8	18.9	545	532	514
Maximum	64.7	16.1	13.3	19.7	568		
Minimum	48.3	11.6	10.5	14.5	459		
Average	61.3	14.3	12.6	18.9	517		
98 %tile	64.7	16.0	13.3	19.7	564		
All the values are expressed as µg/m ³							

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-3							
Location : Vanur (AAQ3)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
07.03.14	51.5	11.8	11.2	18.7	499	482	459
08.03.14	55.3	11.2	12.2	17.9	477	462	454
14.03.14	62.1	15.3	12.5	18.4	499	484	479
15.03.14	57.4	15.0	11.9	18.1	517	507	499
21.03.14	60.4	14.2	12.7	18.0	551	532	522
22.03.14	62.3	15.5	12.0	18.3	553	537	517
28.03.14	61.8	11.2	12.2	17.3	537	522	507
29.03.14	61.7	13.9	12.5	18.4	522	504	489
11.04.14	60.0	13.9	12.1	18.6	519	514	499
12.04.14	62.1	15.6	12.6	16.9	531	524	506
18.04.14	58.3	11.5	12.9	17.1	521	494	472
19.04.14	61.4	15.5	12.9	18.8	531	516	520
25.04.14	57.6	14.8	11.2	18.6	536	526	504
26.04.14	61.4	14.0	12.7	18.1	549	509	494
23.04.14	61.1	14.4	12.9	18.6	511	494	477
24.04.14	60.0	14.8	12.5	18.9	484	474	460
03.05.14	62.8	15.0	12.4	18.9	494	479	467
04.05.14	46.8	11.2	12.2	18.6	489	472	450
09.05.14	60.4	14.9	11.6	17.4	467	452	445
10.05.14	55.0	15.1	12.9	18.6	489	474	470
16.05.14	61.8	12.3	12.0	17.8	506	497	489
17.05.14	62.1	15.2	12.1	18.9	533	539	511
23.05.14	61.4	13.7	12.3	17.5	536	526	506
24.05.14	62.8	12.9	12.7	16.9	545	511	497
30.05.14	59.3	14.7	12.9	17.2	511	494	479
31.05.14	58.8	12.3	12.4	18.3	529	516	499
Maximum	62.8	15.6	12.9	18.9	553		
Minimum	46.8	11.2	11.2	16.9	445		
Average	59.4	13.8	12.3	18.1	502		
98 %tile	62.8	15.6	12.9	18.9	550		
All the values are expressed as µg/m ³							

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-4							
Location : Pudupakkam (AAQ4)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
03.03.14	50.5	11.5	10.9	18.3	489	472	450
04.03.14	54.1	11.0	13.0	19.4	467	452	445
10.03.14	60.8	15.0	13.2	19.0	489	474	469
11.03.14	56.2	14.7	12.6	19.6	506	496	489
17.03.14	59.2	13.9	13.1	19.5	540	521	511
18.03.14	61.0	15.2	13.1	18.9	542	526	506
24.03.14	60.6	11.0	12.9	18.9	526	511	496
25.03.14	60.4	13.6	13.2	19.0	511	494	479
01.04.14	58.8	13.6	12.8	18.3	508	503	489
02.04.14	60.8	15.3	12.4	18.7	520	513	496
07.04.14	57.1	11.3	11.8	18.7	510	484	462
08.04.14	60.1	15.2	12.6	19.4	520	506	509
14.04.14	56.4	14.5	10.9	18.2	525	515	494
15.04.14	60.1	13.7	12.4	18.7	538	498	484
21.04.14	59.9	14.1	12.8	19.2	501	484	467
22.04.14	58.7	14.5	12.2	18.5	474	465	450
28.04.14	61.5	14.7	13.1	18.5	484	469	457
29.04.14	45.9	11.0	12.0	18.2	479	462	441
05.05.14	59.2	14.6	12.4	19.0	457	443	436
06.05.14	53.9	14.8	11.6	18.2	479	465	460
12.05.14	60.6	12.1	12.7	17.4	496	486	479
13.05.14	60.8	14.9	12.8	18.5	522	528	501
19.05.14	60.1	13.4	13.0	17.1	525	515	496
20.05.14	61.5	12.6	13.2	16.6	534	501	486
26.05.14	58.0	14.4	12.6	16.9	501	484	469
27.05.14	57.6	12.1	13.1	18.0	518	506	489
Maximum	61.5	15.3	13.2	19.6	542		
Minimum	45.9	11.0	10.9	16.6	436		
Average	58.2	13.6	12.6	18.5	492		
98 %tile	61.5	15.2	13.2	19.6	539		
All the values are expressed as µg/m ³							

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-5							
Location : Karasur (AAQ5)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
03.03.14	47.2	9.6	13.5	17.4	453	441	429
04.03.14	47.3	11.4	13.1	16.8	443	429	414
10.03.14	37.0	11.6	12.3	13.6	421	412	400
11.03.14	48.6	12.0	12.7	15.3	429	417	406
17.03.14	38.0	11.8	13.3	14.3	425	410	392
18.03.14	46.1	12.0	14.1	13.7	406	394	388
24.03.14	46.0	12.5	13.7	13.1	425	412	408
25.03.14	47.6	11.6	12.9	13.1	439	431	425
01.04.14	44.0	12.1	13.3	17.0	444	440	429
02.04.14	46.6	11.7	12.7	16.4	454	448	435
07.04.14	44.8	12.1	13.1	16.4	446	425	405
08.04.14	45.8	9.8	12.5	13.1	454	442	437
14.04.14	45.5	11.1	11.9	16.0	452	450	433
15.04.14	47.0	10.9	11.7	13.0	448	437	425
21.04.14	48.5	12.1	12.5	16.0	438	425	409
22.04.14	47.9	10.7	11.5	16.2	417	407	396
28.04.14	48.5	11.5	12.3	13.0	425	413	402
29.04.14	48.4	10.5	6.2	16.0	421	405	388
05.05.14	46.9	11.7	12.5	16.8	402	390	384
06.05.14	36.4	9.6	12.9	16.2	421	407	404
12.05.14	45.8	12.0	12.0	13.1	435	427	421
13.05.14	46.4	12.1	12.7	14.7	452	446	438
19.05.14	47.3	12.3	13.3	13.7	454	450	435
20.05.14	48.4	12.6	12.6	13.1	450	438	427
26.05.14	48.5	9.8	12.9	13.5	438	425	413
27.05.14	47.8	11.5	12.3	14.3	452	442	429
Maximum	48.6	12.6	14.1	17.4	454		
Minimum	36.4	9.6	6.2	13.0	384		
Average	45.9	11.4	12.5	14.8	425		
98 %tile	48.6	12.6	13.9	17.2	454		
All the values are expressed as µg/m ³							

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-6							
Location : Turuvai (AAQ6)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
05.03.14	49.0	12.4	11.6	16.4	460	446	439
06.03.14	47.2	12.1	11.8	15.7	481	467	462
12.03.14	49.0	11.4	12.2	14.4	498	489	481
13.03.14	51.0	11.7	12.0	14.3	524	512	503
19.03.14	52.6	12.3	12.2	13.2	526	517	498
20.03.14	52.9	15.6	12.7	13.8	517	503	489
26.03.14	49.3	12.6	11.8	14.0	503	486	472
27.03.14	52.5	11.9	11.4	13.9	519	508	491
03.04.14	51.8	13.2	12.3	16.0	518	515	501
04.04.14	50.8	11.7	11.9	16.4	523	525	508
09.04.14	48.3	12.1	12.3	16.4	520	496	474
10.04.14	50.3	13.1	12.1	15.4	508	518	511
16.04.14	48.2	11.0	11.3	16.0	489	528	506
17.04.14	49.4	10.8	11.1	16.4	525	511	496
23.04.14	49.3	11.5	12.3	16.0	513	496	479
24.04.14	48.2	10.6	10.9	16.2	486	477	462
01.05.14	51.9	12.9	11.7	16.2	496	482	469
02.05.14	52.4	10.4	10.7	16.0	491	474	453
07.05.14	48.4	11.5	11.9	15.8	469	455	448
08.05.14	49.1	11.9	12.1	15.2	491	477	472
14.05.14	47.6	11.0	12.0	13.9	508	499	491
15.05.14	49.5	12.7	12.3	13.7	511	523	513
21.05.14	49.8	12.3	12.5	13.7	513	528	508
22.05.14	51.4	11.6	12.6	13.3	528	513	499
28.05.14	41.2	11.9	12.1	13.5	513	496	482
29.05.14	47.7	11.3	11.7	13.3	525	518	501
Maximum	52.9	15.6	12.7	16.4	528		
Minimum	41.2	10.4	10.7	13.2	448		
Average	49.6	12.0	11.9	15.0	496		
98 %tile	52.7	14.4	12.7	16.4	528		
All the values are expressed as µg/m ³							

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-7							
Location : Thiruchitrambalam(AAQ7)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
05.03.14	54.9	9.8	12.9	19.1	511	498	484
06.03.14	46.9	13.0	12.4	18.4	507	489	469
12.03.14	51.0	12.6	12.5	18.1	484	471	462
13.03.14	55.7	12.3	13.2	19.1	507	491	487
19.03.14	44.9	11.7	12.9	17.8	524	516	507
20.03.14	50.7	12.8	11.0	18.8	549	538	529
26.03.14	50.6	9.8	12.9	18.4	551	542	524
27.03.14	45.3	11.4	12.6	19.0	542	529	516
03.04.14	51.0	13.1	13.3	18.4	480	476	464
04.04.14	51.3	12.8	12.8	18.5	492	485	471
09.04.14	45.1	9.9	13.3	18.6	483	460	447
10.04.14	52.0	12.7	12.0	17.1	492	478	474
16.04.14	46.9	12.2	13.1	18.7	497	487	469
17.04.14	54.1	11.5	12.8	18.6	485	474	460
23.04.14	48.2	11.8	13.3	17.5	476	460	444
24.04.14	52.7	12.2	12.6	19.1	450	444	451
01.05.14	47.5	13.1	12.8	18.1	460	446	447
02.05.14	55.6	9.8	12.3	19.1	455	447	442
07.05.14	51.6	12.2	12.8	18.2	451	447	455
08.05.14	53.2	12.4	12.0	17.7	455	441	458
14.05.14	56.6	10.1	13.2	17.2	471	462	455
15.05.14	51.0	12.5	12.3	16.5	494	483	476
21.05.14	52.0	13.6	12.5	17.2	497	487	471
22.05.14	53.2	10.6	13.3	18.7	487	476	462
28.05.14	53.4	12.1	11.0	17.2	476	460	446
29.05.14	52.5	10.1	12.6	17.6	490	478	464
Maximum	56.6	13.6	13.3	19.1	551		
Minimum	44.9	9.8	11.0	16.5	441		
Average	51.1	11.8	12.6	18.2	480		
98 %tile	56.2	13.4	13.3	19.1	545		
All the values are expressed as µg/m ³							

ANNEXURE - V
AMBIENT AIR QUALITY RESULTS

TABLE-8							
Location : Kutturoad (AAQ8)							
Date	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO		
					I	II	III
05.03.14	44.5	12.3	12.6	18.2	433	421	410
06.03.14	45.0	11.6	12.2	17.6	429	414	397
12.03.14	43.8	10.3	11.4	17.0	410	399	391
13.03.14	44.7	13.5	12.0	16.3	429	416	412
19.03.14	44.2	9.7	12.6	15.1	444	436	429
20.03.14	43.2	11.7	13.0	15.9	465	455	448
26.03.14	42.0	12.0	13.2	16.5	466	459	444
27.03.14	40.4	10.4	12.4	16.1	459	448	436
03.04.14	39.6	10.1	12.0	14.5	449	445	434
04.04.14	40.3	10.2	11.3	15.4	458	452	439
09.04.14	44.4	9.7	10.8	17.0	451	430	410
10.04.14	46.1	12.3	11.5	16.8	458	447	441
16.04.14	44.2	12.1	12.2	16.1	462	454	438
17.04.14	41.6	9.8	12.9	17.0	452	441	428
23.04.14	43.0	13.5	13.2	17.8	443	428	413
24.04.14	44.2	10.8	12.0	17.3	421	412	400
01.05.14	45.8	11.0	12.2	16.6	428	417	406
02.05.14	46.3	9.9	12.5	16.1	425	410	393
07.05.14	44.5	13.7	11.5	15.5	406	395	387
08.05.14	45.0	10.0	11.1	14.8	425	412	408
14.05.14	43.5	10.4	10.4	13.8	439	432	425
15.05.14	45.5	9.9	11.0	14.5	460	451	443
21.05.14	45.6	10.3	11.5	15.0	462	454	439
22.05.14	44.7	10.7	11.8	14.7	454	443	432
28.05.14	44.0	11.0	12.2	15.4	443	430	417
29.05.14	45.5	10.2	11.3	16.3	456	447	434
Maximum	46.3	13.7	13.2	18.2	466		
Minimum	39.6	9.7	10.4	13.8	387		
Average	43.9	11.0	12.0	16.0	432		
98 %tile	46.2	13.6	13.2	18.0	463		
All the values are expressed as µg/m ³							

ANNEXURE-VI

FLORISTIC COMPOSITION AROUND PROPOSED PLANT SITE

ANNEXURE – VI
FLORISTIC COMPOSITION AROUND PLANT SITE (10KM RADIUS)

Sr. No.	Technical Name	Family	Life form
I. Agricultural Crops			
1	<i>Sorghum vulgare</i>	Poaceae	Hemicryptophyte
2	<i>Triticum vulgare</i>	Poaceae	Hemicryptophyte
3	<i>Zea mays</i>	Poaceae	Hemicryptophyte
4	<i>Oryza sativa</i>	Poaceae	Hemicryptophyte
5	<i>Solanum tuberosum</i>	Solanaceae	Therophyte
6	<i>Sacharum officinarum</i>	Poaceae	Hemicryptophyte
II. Commercial Crops (including Vegetables)			
7	<i>Abelmoschus indicus</i>	Malvaceae	Therophyte
8	<i>Allium cepa</i>	Liliaceae	Geophyte
9	<i>Allium sativum</i>	Liliaceae	Geophyte
10	<i>Annona squamosa</i>	Annonaceae	Phanerophyte
11	<i>Arachis hypogea</i>	Fabaceae	Geophyte
12	<i>Brassica oleracea var botrydis</i>	Cruciferae	Therophyte
13	<i>Brassica oleracea var capitata</i>	Cruciferae	Therophyte
14	<i>Cajanus cajan</i>	Fabaceae	Therophyte
15	<i>Carica papaya</i>	Caricaceae	Therophyte
16	<i>Catharanthus pusillus</i>	Compositae	Therophyte
17	<i>Cicer arietinum</i>	Fabaceae	Hemicryptophyte
18	<i>Citrus lemon</i>	Rutaceae	Therophyte
19	<i>Colocasia esculenta</i>	Araceae	Geophyte
20	<i>Coreandrum sativum</i>	Umbelliferae	Hemicryptophyte
21	<i>Daucus carota</i>	Umbelliferae	Geophyte
22	<i>Gossypium sp</i>	Malvaceae	Therophyte
23	<i>Lycopersicum esculentus</i>	Solanaceae	Therophyte
24	<i>Mangifera indica</i>	Anacardiaceae	Phanerophyte
25	<i>Memordia charantia</i>	Cucurbitaceae	Therophyte
26	<i>Pepaver somniferum</i>	Papaveraceae	Hemicryptophyte
27	<i>Pisum sativum</i>	Fabaceae	Therophyte
28	<i>Psidium guava</i>	Myrtaceae	Phanerophyte
29	<i>Raphanus sativa</i>	Cruciferae	Geophyte
30	<i>Trichosanthes anguina</i>	Cucurbitaceae	Therophyte
31	<i>Solanum melongena</i>	Solanaceae	Hemicryptophyte
32	<i>Solanum sp(Chillies)</i>	Solanaceae	Hemicryptophyte
33	<i>Helianthus annulatus</i>	Compositae	Hemicryptophyte
III. Plantations			
34	<i>Acacia nilotica</i>	Mimosaceae	Phanerophyte
35	<i>Albizia lebbek</i>	Mimosaceae	Phanerophyte
36	<i>Albizia odoratissima</i>	Mimosaceae	Phanerophyte
37	<i>Albizia procera</i>	Mimosaceae	Phanerophyte
38	<i>Anacardium occidentale</i>	Anacardiaceae	Phanerophyte
39	<i>Azadirachta indica</i>	Meliaceae	Phanerophyte
40	<i>Bauhinia variegata</i>	Caesalpinaceae	Phanerophyte
41	<i>Bauhinia purpuria</i>	Caesalpinaceae	Phanerophyte
42	<i>Bambusa arundinacea</i>	Poaceae	Phanerophyte
43	<i>Butea superba</i>	Caesalpinaceae	Phanerophyte
44	<i>Butea frondosa</i>	Caesalpinaceae	Phanerophyte
45	<i>Eucalyptus sp</i>	Myrtaceae	Phanerophyte
46	<i>Casuarina equisetifolia</i>	Casuarinaceae	Phanerophyte
47	<i>Delonix regia</i>	Caesalpinaceae	Phanerophyte
48	<i>Leucena leucophloe</i>	Caesalpinaceae	Phanerophyte
IV. Natural Vegetation/Forest Type			
49	<i>Abrus precatorius</i>	Fabaceae	Therophyte
50	<i>Abutilon indicum</i>	Malvaceae	Phanerophyte
51	<i>Acacia Arabica</i>	Mimosaceae	Phanerophyte
52	<i>Acacia leucophloe</i>	Mimosaceae	Phanerophyte

ANNEXURE – VI
FLORISTIC COMPOSITION AROUND PLANT SITE (10KM RADIUS)

Sr. No.	Technical Name	Family	Life form
53	<i>Achras sapota</i>	Sapotaceae	Phanerophyte
54	<i>Acalypha lanceolata</i>	Euphorbiaceae	Therophyte
55	<i>Achyranthes aspera</i>	Amaranthaceae	Therophyte
56	<i>Aegle marmelos</i>	Rutaceae	Phanerophyte
57	<i>Aerva lanata</i>	Compositae	Phanerophyte
58	<i>Agave wightii</i>	Agavaceae	Phanerophyte
59	<i>Ageratum conyzoides</i>	Compositae	Therophyte
60	<i>Ailanthes excelsa</i>	Simaroubaceae	Phanerophyte
61	<i>Alangium lamarkii</i>	Alangiceae	Phanerophyte
62	<i>Aloe barbedensis</i>	Agavaceae	Geophyte
63	<i>Alternanthera sessilis</i>	Amaranthaceae	Therophyte
64	<i>Alysicarpus hamosus</i>	Fabaceae	Therophyte
65	<i>Alysicarpus monilifer</i>	Fabaceae	Therophyte
66	<i>Ammania baccafera</i>	Lytharaceae	Therophyte
67	<i>Antidesma diandrum</i>	Euphorbiaceae	Hemicryptophyte
68	<i>Argemone mexicana</i>	Papevaraceae	Therophyte
69	<i>Asparagaus racemosus</i>	Liliaceae	Therophyte
70	<i>Atalantia monophylla</i>	Rutaceae	Therophyte
71	<i>Azadirachta indica</i>	Meliaceae	Phanerophyte
72	<i>Barleria prionoites</i>	Acanthaceae	Therophyte
73	<i>Blepharis asperima</i>	Acanthaceae	Phanerophyte
74	<i>Blumea lacera</i>	Compositae	Therophyte
75	<i>Boerheavia chinensis</i>	Nycataginaceae	Therophyte
76	<i>Boerheavia diffusa</i>	Nyctaginaceae	Therophyte
77	<i>Bombax ceiba</i>	Bombacaceae	Phanerophyte
78	<i>Borreria hispida</i>	Rubiaceae	Therophyte
79	<i>Borreria stricta</i>	Rubiaceae	Therophyte
80	<i>Borassus flabellifera</i>	Palmae	Phanerophyte
81	<i>Brassica camprestris</i>	Cruciferae	Therophyte
82	<i>Buchanania angustifolia</i>	Anacardiaceae	Phanerophyte
83	<i>Caesalpina pulcherima</i>	Caesalpinaceae	Phanerophyte
84	<i>Calotropis gigantia</i>	Asclepiadaceae	Phanerophyte
85	<i>Calotropis procera</i>	Asclpiadaceae	Phanerophyte
86	<i>Canna indicda</i>	Cannaceae	Therophyte
87	<i>Canthium diddymum</i>	Rubiaceae	Phanerophyte
88	<i>Capparis aphylla</i>	Capparidaceae	Therophyte
89	<i>Capparis deciduas</i>	Capparidaceae	Phanerophyte
90	<i>Capsicum annulatum</i>	Solanaceae	Therophyte
91	<i>Careya arborea</i>	Palmae	Phanerophyte
92	<i>Carissa carandus</i>	Apocyanaceae	Phanerophyte
93	<i>Casearia graveolens</i>	Samydiaceae	Phanerophyte
94	<i>Cassia auriculata</i>	Caesalpinaceae	Therophyte
95	<i>Cassia occidentalis</i>	Caesalpinaceae	Therophyte
96	<i>Cassia absus</i>	Caesalpinaceae	Therophyte
97	<i>Cassia tora</i>	Caesalpinaceae	Phanerophyte
98	<i>Cayratia terifolia</i>	Vitaceae	Phanerophyte
99	<i>Caryota urens</i>	Palmae	Phanerophyte
100	<i>Ceiba pentandra</i>	Bombacaceae	Phanerophyte
101	<i>Cestrum diurnum</i>	Rubiaceae	Theophyte
102	<i>Cestrum noctrunum</i>	Rubiaceae	Therophyte
103	<i>Chloris varigata</i>	Poaceae	Therophyte
104	<i>Chrysanthemum sp</i>	Compositae	Therophyte
105	<i>Cissus quadrangularis</i>	Vitaceae	Therophyte
106	<i>Citrus liminoites</i>	Rutaceae	Phanerophyte
107	<i>Citrus media</i>	Rutaceae	Phanerophyte
108	<i>Cleome gynandra</i>	Capparidaceae	Therophyte

ANNEXURE – VI
FLORISTIC COMPOSITION AROUND PLANT SITE (10KM RADIUS)

Sr. No.	Technical Name	Family	Life form
109	<i>Cleome viscosa</i>	Capparidaceae	Therophyte
110	<i>Clitoria ternate</i>	Fabaceae	Therophyte
111	<i>Cocculus villosa</i>	Cucurbitaceae	Phanerophyte
112	<i>Cocos nucifera</i>	Palmae	Phanerophyte
113	<i>Commelina benghalensis</i>	Commelinaceae	Therophyte
114	<i>Cordia dichotoma</i>	Rubiaceae	Phanerophyte
115	<i>Cordia myxa</i>	Rubiaceae	Phanerophyte
116	<i>Cordia rothri</i>	Rubiaceae	Phanerophyte
117	<i>Crataeva adsoni</i>	Capparidaceae	Phanerophyte
118	<i>Crotalaria burhia</i>	Fabaceae	Therophyte
119	<i>Crotalaria medicagenia</i>	Fabaceae	Therophyte
120	<i>Croton bonplandinum</i>	Amaryllidaceae	Therophyte
121	<i>Cryptostegia grandiflora</i>	Orchidaceae	Hemicryptophyte
122	<i>Cuscuta reflexa</i>	Cuscutaceae	Epiphyte
123	<i>Datura alba</i>	Solanaceae	Therophyte
124	<i>Datura metal</i>	Solanaceae	Therophyte
125	<i>Delphinium ajacis</i>	Ranunculaceae	Phanerophyte
126	<i>Dendrophthe falcate</i>	Loranthaceae	Hemicryptophyte
127	<i>Echinops echinatus</i>	Compositae	Therophyte
128	<i>Eclipta alba</i>	Compositae	Therophyte
129	<i>Eclipta prostrate</i>	Compositae	Hemicryptophyte
130	<i>Eichhornia crassipes</i>	Pontederiaceae	Hydrophyte
131	<i>Embllica officinale</i>	Euphorbiaceae	Phanerophyte
132	<i>Erythroxylon monogynum</i>	Rubiaceae	Phanerophyte
133	<i>Emilia lajerium</i>	Compositae	Hemicryptophyte
134	<i>Erythrina indica</i>	Papilionaceae	Phanerophyte
135	<i>Euphorbia geniculata</i>	Euphorbiaceae	Therophyte
136	<i>Euphorbia hirta</i>	Euphorbiaceae	Therophyte
137	<i>Euphorbia hyperocifolia</i>	Euphorbiaceae	Therophyte
138	<i>Euphorbia nerifolia</i>	Euphorbiaceae	Phanerophyte
139	<i>Euphorbia neruri</i>	Euphorbiaceae	Therophyte
140	<i>Euphorbia nivula</i>	Euphorbiaceae	Therophyte
141	<i>Euphorbia thymiflora</i>	Euphorbiaceae	Phanerophyte
142	<i>Euphorbia tricauli</i>	Euphorbiaceae	Hemicryptophyte
143	<i>Evolvulus alsinoides</i>	Convolvulaceae	Therophyte
144	<i>Evolvulus numularis</i>	Convolvulaceae	Therophyte
145	<i>Fagonia cretica</i>	Zygophyllaceae	Phanerophyte
146	<i>Feronia elephantum</i>	Rutaceae	Phanerophyte
147	<i>Ficus benghalensis</i>	Moraceae	Phanerophyte
148	<i>Ficus glomerata</i>	Moraceae	Phanerophyte
149	<i>Ficus racemosus</i>	Moraceae	Phanerophyte
150	<i>Flacourtia indica</i>	Flacourtiaceae	Phanerophyte
151	<i>Flacourtia Montana</i>	Flacourtiaceae	Phanerophyte
152	<i>Fumaria indica</i>	Papilionaceae	Hemicryptophyte
153	<i>Gardenia latifolia</i>	Rubiaceae	Phanerophyte
154	<i>Gardenia lucida</i>	Rubiaceae	Phanerophyte
155	<i>Gloriosa superba</i>	Liliaceae	Phanerophyte
156	<i>Gmelina arborea</i>	Rubiaceae	Phanerophyte
157	<i>Gomphrena globosa</i>	Amaranthaceae	Therophyte
158	<i>Gossypium herbaceum</i>	Malvaceae	Therophyte
159	<i>Grewia abutifolia</i>	Tiliaceae	Phanerophyte
160	<i>Grewia salivifolia</i>	Tiliaceae	Phanerophyte
161	<i>Grewia subinaqualis</i>	Tiliaceae	Phanerophyte
162	<i>Gynandropis gynandra</i>	Capparidaceae	Hemicryptophyte
163	<i>Haplanthus verticillatus</i>	Acanthaceae	Therophyte
164	<i>Helictis isora</i>	Rubiaceae	Phanerophyte

ANNEXURE – VI
FLORISTIC COMPOSITION AROUND PLANT SITE (10KM RADIUS)

Sr. No.	Technical Name	Family	Life form
165	<i>Heliotropium indicum</i>	Rubiaceae	Hemicryptophyte
166	<i>Heliotropium ovalifolium</i>	Rubiaceae	Hemicryptophyte
167	<i>Hemidesmus indicus</i>	Asclepiadaceae	Phanerophyte
168	<i>Hibiscus gibbosa</i>	Malvaceae	Therophyte
169	<i>Hibiscus micronthus</i>	Malvaceae	Therophyte
170	<i>Hibiscus ovalifolia</i>	Malvaceae	Therophyte
171	<i>Hibiscus rosa-cianensis</i>	Malvaceae	Therophyte
172	<i>Hyptis suaveolens</i>	Labiatae	Therophyte
173	<i>Ipomea carnea</i>	Convolvulaceae	Phanerophyte
174	<i>Ipomea coccinea</i>	Convolvulaceae	Therophyte
175	<i>Ipomea tuba</i>	Convolvulaceae	Hemicryptophyte
176	<i>Ixora parviflora</i>	Rubiaceae	Phanerophyte
177	<i>Ixora singapuriensis</i>	Rubiaceae	Phanerophyte
178	<i>Jasminum arbores</i>	Oleaceae	Phanerophyte
179	<i>Jatropha gossypifolia</i>	Euphorbiaceae	Therophyte
180	<i>Justicia diffusa</i>	Acanthaceae	Therophyte
181	<i>Lemna minor</i>	Lemnaceae	Hydrophyte
182	<i>Leptodenia pyrotechnica</i>	Asclepiadaceae	Phanerophyte
183	<i>Leptodenia reticulate</i>	Asclepiadaceae	Phanerophyte
184	<i>Leucas aspera</i>	Labiatae	Therophyte
185	<i>Leucas longifolia</i>	Labiatae	Therophyte
186	<i>Lindernbergia ciliate</i>	Scrophulariaceae	Therophyte
187	<i>Loranthus sp</i>	Loranthaceae	Epiphyte
188	<i>Lycopersicum esculentus</i>	Solanaceae	Therophyte
189	<i>Lygodium flexosum</i>	Schiaceae	Therophyte
190	<i>Malvastrum coramandalicum</i>	Malvaceae	Therophyte
191	<i>Mangifera indica</i>	Anacardiaceae	Phanerophyte
192	<i>Marselia quadrifolia</i>	Marseliaceae	Phanerophyte
193	<i>Medicago indica</i>	Papillionaceae	Phanerophyte
194	<i>Medicago lymorpha</i>	Papillionaceae	Therophyte
195	<i>Mimusops hexandra</i>	Sapotaceae	Phanerophyte
196	<i>Memordica diocea</i>	Cucurbitaceae	Therophyte
197	<i>Michaelia champaca</i>	Annonaceae	Phanerophyte
198	<i>Millingtonia hartensis</i>	Bignoniaceae	Phanerophyte
199	<i>Mollugo hirta</i>	Aizoaceae	Therophyte
200	<i>Moringa olerifera</i>	Moringaeae	Phanerophyte
201	<i>Morus alba</i>	Moraceae	Phanerophyte
202	<i>Mucuna prurita</i>	Papillionaceae	Hemicryptophyte
203	<i>Murraya exotica</i>	Rutaceae	Phanerophyte
204	<i>Murraya koenigii</i>	Rutaceae	Phanerophyte
205	<i>Musa paradisica</i>	Musaceae	Therophyte
206	<i>Nelumbium nuciferum</i>	Magnoliaceae	Hydrophyte
207	<i>Nerium indicum</i>	Apocyanaceae	Phanerophyte
208	<i>Nicotiana plubigera</i>	Solanaceae	Hemicryptophyte
209	<i>Nymphia sp</i>	Magnoliaceae	Hydrophyte
210	<i>Ocimum americanum</i>	Labiatae	Therophyte
211	<i>Ocimum basillum</i>	Labiatae	Therophyte
212	<i>Ocimum canum</i>	Labiatae	Therophyte
213	<i>Ocimum sanctum</i>	Labiatae	Therophyte
214	<i>Oldenlandia umbellate</i>	Convolvulaceae	Therophyte
215	<i>Opuntia dillinii</i>	Opuntiaceae	Therophyte
216	<i>Randia dumotorum</i>	Rubiaceae	Phanerophyte
217	<i>Scheleichera trijuga</i>		
218	<i>Dodonea viscosa</i>		Phanerophyte
219	<i>Indigofera pulchella</i>	Papillionaceae	Phanerophyte
220	<i>Pavetta indica</i>		

ANNEXURE – VI
FLORISTIC COMPOSITION AROUND PLANT SITE (10KM RADIUS)

Sr. No.	Technical Name	Family	Life form
221	<i>Prema tomentosa</i>	Rubiaceae	Phanerophyte
222	<i>Odina odier</i>		Phanerophyte
223	<i>Opuntia elator</i>	Cacataceae	Therophyteq
224	<i>Oxalis corniculata</i>	Oxalidaceae	Therophyte
225	<i>Panicum milliria</i>	Poaceae	Hemicryptophyte
226	<i>Panicum notatum</i>	Poaceae	Hemicryptophyte
227	<i>Papaver somniferum</i>	Papaveraceae	Hemicryptophyte
228	<i>Parkinsonia aculata</i>	Mimosaceae	Phanerophyte
229	<i>Parthenium hysterophorus</i>	Compositae	Therophyte
230	<i>Paspalum strobilanthus</i>	Passifloraceae	Hemicryptophyte
231	<i>Passiflora foetida</i>	Passifloraceae	Phanerophyte
232	<i>Pavonia zeylanica</i>	Malvaceae	Phanerophyte
233	<i>Peltophorum ferrusinum</i>	Caesalpinaceae	Phanerophyte
234	<i>Peristrophe bicalculata</i>	Acanthaceae	Therophyte
235	<i>Phoenix aculis</i>	Palmae	Phanerophyte
236	<i>Phyllanthus emblica</i>	Euphorbiaceae	Phanerophyte
237	<i>Phyllanthus nirurii</i>	Euphorbiaceae	Therophyte
238	<i>Phyllanthus reticulates</i>	Euphorbiaceae	Therophyte
239	<i>Physalis minima</i>	Solanaceae	Therophyte
240	<i>Pistia sp</i>	Hydrocaridaceae	Hydrophyte
241	<i>Pithocolobium dulce</i>	Mimosaceae	Phanerophyte
242	<i>Polyalthia longifolia</i>	Annonaceae	Phanerophyte
243	<i>Pongamia pinnata</i>	Fabaceae	Phanerophyte
244	<i>Portulaca oleracea</i>	Portulaccaceae	Therophyte
245	<i>Prosopis cineraria</i>	Mimosaceae	Phanerophyte
246	<i>Prosopis juliflora</i>	Mimosaceae	Phanerophyte
247	<i>Prosopis spicegera</i>	Mimosaceae	Phanerophyte
248	<i>Psidium guava</i>	Myrtaceae	Phanerophyte
249	<i>Punica granulatam</i>	Puniaceae	Therophyte
250	<i>Raphanus sativus</i>	Cruciferae	Therophyte
251	<i>Rhus mysoorensis</i>	Rosaceae	Phanerophytes
252	<i>Saccharum munja</i>	Poaceae	Hemicryptophyte
253	<i>Salmaalial malabarica</i>	Salmaliaceae	Phanerophyte
254	<i>Sapindus emerginatus</i>	Sapindaceae	Phanerophyte
255	<i>Sapindus emerginatus</i>	Sapindaceae	Phanerophyte
256	<i>Saraca indica</i>	Caesalpinaceae	Therophyte
257	<i>Sida cordifolia</i>	Malvaceae	Phanerophyte
258	<i>Sansvera suavalens</i>	Agavaceae	Therophyte
259	<i>Sida orientalis</i>	Malvaceae	Phanerophyte
260	<i>Sida vernanifolia</i>	Malvaceae	Hemicryptophyte
261	<i>Sesamum indicum</i>	Pedaliaceae	Hemicryptophyte
262	<i>Solanum nigrum</i>	Solanaceae	Therophyte
263	<i>Solanum suratensis</i>	Solanaceae	Phanerophyte
264	<i>Solanum xanthocarpum</i>	Solanaceae	Therophyte
265	<i>Sterculia villosa</i>	Tiliaceae	Therophyte
266	<i>Sygygium cumini</i>	Myrtaceae	Phanerophyte
267	<i>Tagetus sp</i>	Compositae	Therophyte
268	<i>Tamarindus indica</i>	Caesalpinaceae	Phanerophyte
269	<i>Tecomella undulate</i>	Bignoniaceae	Therophyte
270	<i>Tectona grandis</i>	Verbinaceae	Phanreophyte
271	<i>Tephrosia purpuria</i>	Fabaceae	Therophyte
272	<i>Terminalia bellarica</i>	Combretaceae	Phanerophyte
273	<i>Terminalia chebula</i>	Combretaceae	Phanerophyte
274	<i>Terminalia tomentosa</i>	Combretaceae	Phanerophyte
275	<i>Thespesia populanea</i>	Malvaceae	Phanerophyte
276	<i>Thespesia lampas</i>	Malvaceae	Phanerophyte

ANNEXURE – VI
FLORISTIC COMPOSITION AROUND PLANT SITE (10KM RADIUS)

Sr. No.	Technical Name	Family	Life form
277	<i>Tinospora cordifolia</i>	Rhamnaceae	Therophyte
278	<i>Tragus biflorus</i>	Poaceae	Hemicryptophyte
279	<i>Trapa bispinosa</i>	Trapaceae	Hydrophyte
280	<i>Trapa natans</i>	Trapaceae	Hemicryptophyte
281	<i>Tribulus terrestris</i>	Zygophyllaceae	Therophyte
282	<i>Tridax procumbens</i>	Compositae	Therophyte
283	<i>Trigonella foenumgracum</i>	Fabaceae	Hemicryptophyte
284	<i>Trigonella corniculata</i>	Fabaceae	Hemicryptophyte
285	<i>Tripogon jacquimontii</i>	Poaceae	Hemicryptophyte
286	<i>Triumferta pilosa</i>	Tiliaceae	
287	<i>Vernonia cinera</i>	Compositae	Therophyte
288	<i>Vicoa indica</i>	Compositae	Phanerophyte
289	<i>Vitex negundo</i>	Verbinaceae	Therophyte
290	<i>Vitis vermifera</i>	Vitaceae	Therophyte
291	<i>Wrightia tomentosa</i>	Apocyanaceae	Phanerophyte
292	<i>Xanthium strumariumk</i>	Compositae	Therophyte
293	<i>Yucca gloriosa</i>	Agavaceae	Therophyte
294	<i>Zizyphus jujube</i>	Rhamnaceae	Phanerophyte
295	<i>Zizyphus mauritiana</i>	Rhamnaceae	Phanerophyte
296	<i>Zizyphus nummularis</i>	Rhamnaceae	Phanerophyte
297	<i>Zizyphus oenoplica</i>	Rhamnaceae	Therophyte
298	<i>Zornia gobbosa</i>	Compositae	Therophyte
Grasslands			
299	<i>Cenchrus ciliaris</i>	Poaceae	Hemicryptophyte
300	<i>Apluda mutica</i>	Poaceae	Hemicryptophyte
301	<i>Chloris dolichosta</i>	Poaceae	Hemicryptophyte
302	<i>Cyanodactylon sp</i>	Poaceae	Geophyte
303	<i>Dichanthium annulatum</i>	Poaceae	Hemicryptophyte
304	<i>Sachharum spontanseum</i>	Poaceae	Hemicryptophyte
305	<i>Themeda quadrivalvis</i>	Poaceae	Hemicryptophyte
306	<i>Aristida adscensionsis</i>	Poaceae	Hemicryptophyte
307	<i>Cymbopogon jwarancusa</i>	Cyperaceae	Hemicryptophyte
308	<i>Cyperus aristatus</i>	Cyperaceae	Therophyte
309	<i>Cyperus difformis</i>	Cyperaceae	Therophyte
310	<i>Dactylectinium annualatum</i>	Poaceae	Therophyte
311	<i>Digetaria bicornis</i>	Poaceae	Hemicryptophyte
312	<i>Digetaria Segetaria</i>	Poaceae	Hemicryptophyte
313	<i>Digetaria stricta</i>	Poaceae	Hemicryptophyte
314	<i>Digetaria adscendens</i>	Poaceae	Hemicryptophyte
315	<i>Eragrostis biferia</i>	Poaceae	Therophyte
316	<i>Eragrostis diahena</i>	Poaceae	Therophyte
317	<i>Eragrostis japonica</i>	Poaceae	Therophyte
318	<i>Eragrostis tenella</i>	Poaceae	Therophyte
319	<i>Fibrystylis dichotoma</i>	Poaceae	Hemicryptophyte
320	<i>Ichnocarpus frutenscens</i>	Poaceae	Therophyte
321	<i>Setaria glauca</i>	Cyperaceae	Hemicryptophyte
322	<i>Themeda ciliate</i>	Cyperaceae	Hemicryptophyte
	Endemic species	No endemic species recorded/reported as per BSI records	
	Endangered species	No endangered plant species recorded/reported as per BSI	

ANNEXURE-VII

FAUNA AND THEIR CONSERVATION STATUS FROM STUDY AREA

ANNEXURE-VII
FAUNA AND THEIR CONSERVATION STATUS FROM STUDY AREA

Sr. No.	Scientific Name	English Name/ Local Name	Conservation status as per Wild Life Act (1972)
	Aves		
1	<i>Quills contronix</i>	Grey quail	Sch-IV
2	<i>Corvus corvus</i>	Jungle crow	Sch-IV
3	<i>Corvus splendens</i>	House crow	Sch-IV
4	<i>Turdoides striatus</i>	White headed babbler	Sch-IV
5	<i>Aegithina tiphia</i>	Iora	Sch-IV
6	<i>Pycnonotus cafer</i>	Red vented bulbul	Sch-IV
7	<i>Pycnonotus jokokus</i>	White browed Bulbul	Sch-IV
8	<i>Saxicoloides fulicata</i>	Indian robin	Sch-IV
9	<i>Columbus livia</i>	Blue Rock Pigeon	Sch-V
10	<i>Copsychus saularis</i>	Magpie Robin	Sch-IV
11	<i>Tchitrea paradisi</i>	Paradise Flycatcher	Sch-IV
12	<i>Tephrodornis pondiceraianus</i>	Common Wood shrike	Sch-IV
13	<i>Lalage sykesi</i>	Black headed cochoo Shrike	Sch-IV
14	<i>Artamus fuscus</i>	Ashy Swallow Shrike	Sch-IV
15	<i>Dicrurus macrocerus</i>	Black Drongo	Sch-IV
16	<i>Dicrurus longicaudatus</i>	Grey Drongo	Sch-IV
17	<i>Oriolus oriolus</i>	Indian Oriole	Sch-IV
18	<i>Temenuchus pagodarum</i>	Brahmny Myna	Sch-IV
19	<i>Acridotheres tristis</i>	Common myna	Sch-IV
20	<i>Ploceus philippines</i>	Weaver bird	Sch-IV
21	<i>Uroloncha striata</i>	Spotted munia	Sch-IV
22	<i>Passer domesticus</i>	House Sparrow	Sch-IV
23	<i>Cinnyris asiatica</i>	Purple Sunbird	Sch-IV
24	<i>Brachypternus bengalensis</i>	Malabar Golden Packed wood	Sch-IV
25	<i>Megalaima merulinus</i>	Indian Cuckoo	Sch-IV
26	<i>Hierococys varius</i>	Common Hawk Cuckoo	Sch-IV
27	<i>Eudynamis scolopaceus</i>	Koel	Sch-V
28	<i>Centropus sinensis</i>	Crow Pheasant	Sch-IV
29	<i>Psittacula krammeri</i>	Rose ringed parakeet	Sch-IV
30	<i>Coracias benghalensis</i>	Indian Roller	Sch-IV
31	<i>Merops orinetalis</i>	Common Bee Eater	Sch-IV
32	<i>Alcedo atthis</i>	Common Kingfisher	Sch-IV
33	<i>Microfus affinis</i>	House swift	Sch-IV
34	<i>Cyprinus parvus</i>	Palm swift	Sch-IV
35	<i>Caprimulgus asiaticus</i>	Common Indian Night Jar	Sch-IV
36	<i>Tylo alba</i>	Barn Owl	Sch-IV
37	<i>Haliastur indus</i>	Brahmny kite	Sch-I
38	<i>Milvus migrans</i>	Pariah kite	Sch-I
39	<i>Circus aeruginosus</i>	Marsh harrier	Sch-IV
40	<i>Chalcophaps indica</i>	Emerald Dove	Sch-IV
41	<i>Lobvanella indicus</i>	Redwattled Lapwing	Sch-IV
42	<i>Lobpluvia malabaraica</i>	Yellow wattled lapwing	Sch-IV
43	<i>Anhinga melanogaster</i>	Darter	Sch-V
44	<i>Egretta garzetta</i>	Little Egret	Sch-IV
45	<i>Bubulcus ibis</i>	Cattle Egret	Sch-IV
46	<i>Ardeola grayii</i>	Pond Heron	Sch-IV
47	<i>Sterna albifrons</i>	Indian River Tern	Sch-IV
48	<i>Galerida malabarica</i>	Malabar Crested Lark	Sch-IV
49	<i>Platalea leucorodia</i>	Eurasian Spoonbill	Sch-I
50	<i>Pandion haliaetus</i>	Osprey	Sch-I

ANNEXURE-VII
FAUNA AND THEIR CONSERVATION STATUS FROM STUDY AREA

Sr. No.	Scientific Name	English Name/ Local Name	Conservation status as per Wild Life Act (1972)
51	<i>Haliaeetus leucogaster</i>	White-bellied sea eagle	Sch-I
52	<i>Pavo cristatus</i>	Indian Peafowl	Sch-I
	Reptiles		
53	<i>Ptyas mucosus</i>	Rat snake	Sch-II
54	<i>Nerodia piscator</i>	Fresh water snake	Sch-III
55	<i>Naja naja</i>	Cobra	Sch-IV
56	<i>Bungarus candidus</i>	Krait	Sch-III
57	<i>Vipera russeli</i>	Viper	Part-II of Sch-II
	Butterflies		
58	<i>Pachliopta hector</i>	Crimson rose	Sch-I
59	<i>Common Pierrot</i>	Castalius rosimon	Sch-I
60	<i>Papilo demoleus</i>	Lime butterfly	-
61	<i>Graphium agamemnos</i>	Tailed jay	-
62	<i>Junonia atlites</i>	Grey pansey	-
63	<i>Juninia almana</i>	Peacock pansey	-
64	<i>Neptis hylas</i>	Common sailor	Sch-IV
65	<i>Parantica aglea</i>	Glassy tiger	Sch-IV
	Amphibian		
66	<i>Rana hexadactyla</i>	Frog	Sch-IV
67	<i>Rana tigrina</i>	Bull frog	Sch-IV
	Mammals		
68	<i>Lepus nigricollis</i>	Black naped Hare	Sch-IV
69	<i>Paradoxurus hermaphroditus</i>	Asian Palm Civet	Sch-II
70	<i>Funambulus palmarum</i>	Three Striped palm Squirrel	Sch-IV
71	<i>Axis axis</i>	Spotted deer	Sch-IV
72	<i>Herpestes edwardii</i>	Common mongoose	Sch-II
73	<i>Bandicota indica</i>	Bandicoot rat	Sch-V
74	<i>Mus sp.</i>	Mice	Sch-V

ANNEXURE-VIII

LANDUSE PATTERN OF STUDY AREA

ANNEXURE-VIII
LANDUSE DETAILS OF STUDY AREA

Sr. No.	Village	Forest	Irrigated land	Un- Irrigated land	Cultivable waste land	Area not available for cultivation	Total
0-3 km							
1	Akasampattu	0	155.17	10.14	0.61	27.88	193.8
2	Sedarapet	0	1.64	76.56	118.8	194.45	391.45
3	Acharampattu	0	81.45	186.71	72.19	127.81	468.16
4	Ravutharayankuppam	0	66.93	1.52	1.86	0	70.31
5	Tiruchitrambalam	0	81.45	186.71	72.19	127.81	468.16
	Sub Total	0	386.64	461.64	265.65	477.95	1591.88
3-7 km							
1	Pulichapallam	0	199.85	73.9	161.18	292.02	726.95
2	Toruvai	0	16.23	167.24	0.05	55.71	239.23
3	Olundiyappattu	0	158.65	355.64	92.17	158.32	764.78
4	Rayattai	0	86.56	149.01	3.5	23.15	262.22
5	Appirambattu	0	163.32	1.57	44.1	8.1	217.09
6	Royapudupakkam	26.21	489.88	2.59	0	56.81	575.49
7	Alankuppam	0	44.7	0	0	34.89	79.59
8	Irumbai	0	23.51	767.57	0	36.69	827.77
9	Pattanur	0	28.46	219.56	44.12	0	292.14
10	Puthurai	0	187.4	243.78	6.14	55.78	493.1
11	Mettupalaiyam	0	0	180.42	0	116.57	296.99
12	Kadapperikuppam	0	131.06	3.73	32.81	120.39	287.99
13	Oussudu	0	120.92	0.89	1.41	435.62	558.84
14	Thuthipet	0	48.49	23.1	27.84	91.81	191.24
15	Karasur	0	45.74	71.3	4.49	60.04	181.57
16	Valudavur	0	119.75	191.24	0	147.5	458.49
17	Kallerikuppam	0	108.72	61.26	4.7	14.79	189.47
18	Ottai	0	31.83	269.09	2.05	87	389.97
19	Pudupakkam	0	90.2	83.83	1.16	5.15	180.34
20	Vanur	0	352.08	526.28	2.79	261.05	1142.2
	Sub Total	26.21	2447.35	3392	428.51	2061.39	8355.46
7-10 km							
1	Vilvanatham	0	0	263.08	119.32	103.28	485.68
2	Kodur	0	127.96	143.37	0	210.81	482.14
3	Tailapuram	0	246.45	347.73	3.14	30.41	627.73
4	Kenippattu	0	108.74	253.12	39.62	27.17	428.65
5	Nesal	0	72.99	284.36	0	77.48	434.83
6	Mattur	0	26.31	74.9	0	141	242.21
7	Bommayapalayam	0	54.51	975.1	0	78.63	1108.24
8	Karuvapakkam	0	125	50.83	3.99	39.07	218.89
9	Pudupalayam	0	48.94	0	0	0	48.94
10	Kurumparam	24.4	135.2	25.6	24.6	1.2	211
11	Perambai	0	28.53	84.7	0	64.83	178.06
12	Agaram (Then)	0	120.64	25.31	0	8.18	154.13
13	Poraiyur	0	118.67	0	17.89	1.69	138.25
14	Koodapakkam	0	137.39	0.23	2.82	115.73	256.17
15	Ulaivaikkal	0	120.59	2.41	2.47	71.17	196.64
16	Ramanathapuram	0	181.02	6.36	16.09	86.19	289.66
17	Pillaiyarkuppam	0	135.02	6.2	2.74	69.12	213.08
18	Sellipattu	0	169.9	1.49	1.3	86.99	259.68
19	Kalithirthalkuppam	0	234.35	12.19	23.37	162.78	432.69
20	Koonimedu	50.61	91.69	83.98	0	981.16	1207.44
21	Kaliingamalai	0	10.79	117.95	0	22.66	151.4
22	Vambupet	0	116.89	16.94	1.68	27.17	162.68
23	Sengamedu	0	67.57	9.85	0	0	77.42
24	Kadagampattu	0	53.48	67	0.81	0	121.29
25	Kondalamkuppam	0	59.68	242.84	0.13	3.67	306.32
26	Parangani	0	121.26	561.91	81.21	1.42	765.8
	Sub Total	75.01	2713.57	3657.45	341.18	2411.81	9199.02
	Grand Total	101.22	5547.56	7511.09	1035.34	4951.15	19146.36

ANNEXURE-IX

DEMOGRAPHIC DETAILS OF STUDY AREA

ANNEXURE-IX
DEMOGRAPHIC DETAILS OF STUDY AREA

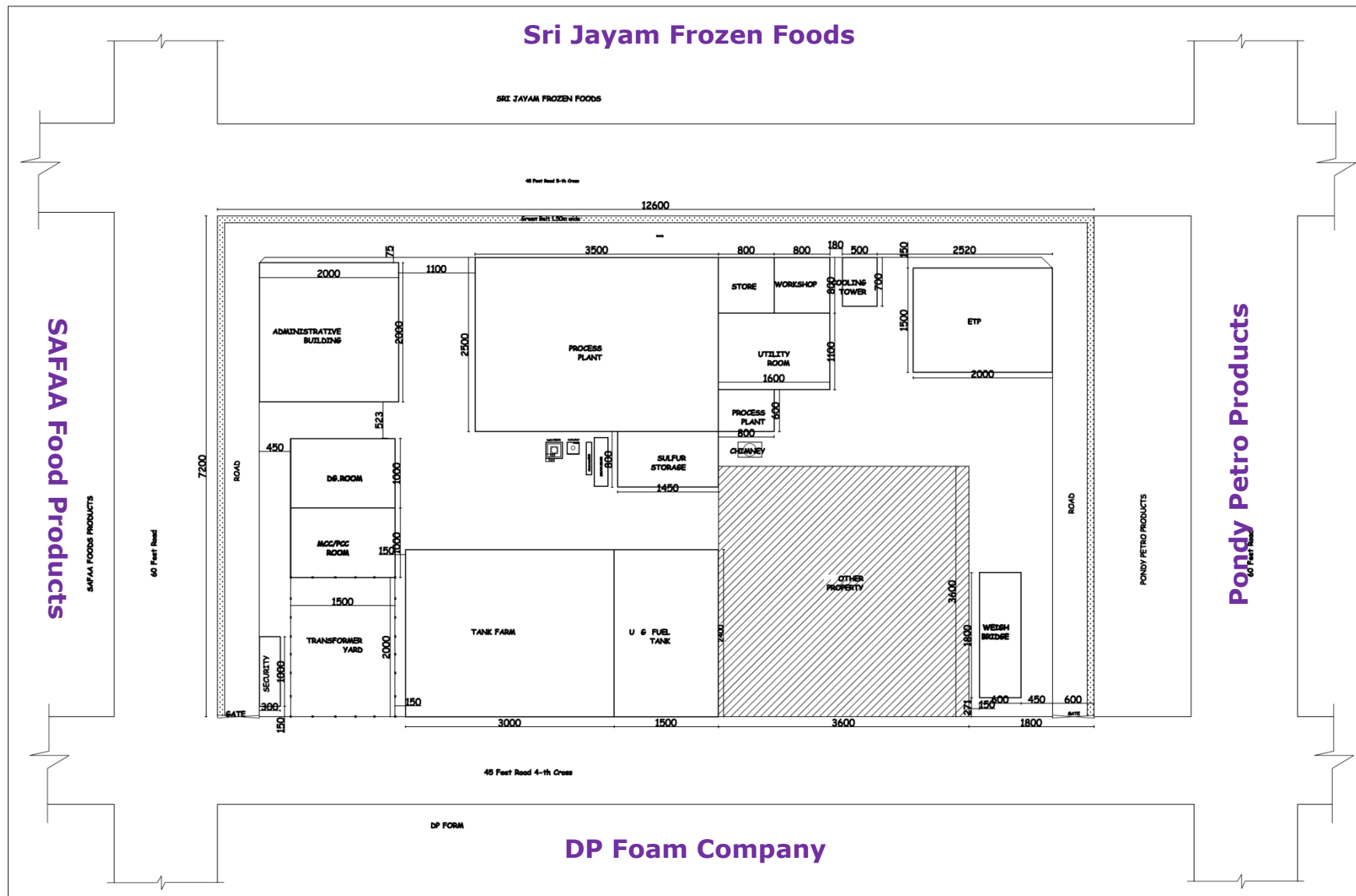
0-3 km	TRU	No.of HH	Total Population	Total Male	Total Female	Total SC	Total ST	Total Literate	Male Literate	Female Literate	Total Workers	Marginal Workers	Non Workers
Akasampattu	Rural	355	1528	815	713	853	7	1145	662	483	795	405	733
Tiruchitrambalam	Rural	1951	8031	3984	4047	1421	33	6214	3269	2945	2956	306	5075
avutharayankuppam	Rural	304	1376	692	684	756	0	889	499	390	650	168	726
Acharampattu	Rural	319	1251	631	620	236	68	939	509	430	468	45	783
Sedarapet	Rural	1149	4756	2376	2380	1393	0	3507	1900	1607	1712	332	3044
		4078	16942	8498	8444	4659	108	12694	6839	5855	6581	1256	10361
3-7 km													
Appirambattu	Rural	291	1307	670	637	168	0	848	497	351	691	267	616
Toruvai	Rural	192	800	388	412	192	21	578	317	261	415	76	385
Pulichapallam	Rural	1369	6397	3397	3000	3055	68	4552	2674	1878	3034	1007	3363
Rayattai	Rural	11	46	23	23	17	4	29	17	12	26	10	20
Royapudupakkam	Rural	533	2565	1271	1294	1029	117	1813	980	833	976	28	1589
Olundiyappattu	Rural	442	1831	884	947	598	167	1165	623	542	1059	181	772
Alankuppam	Rural	296	1200	598	602	336	0	726	423	303	525	328	675
Irumbai	Rural	1478	5830	2921	2909	1041	28	3771	2139	1632	2669	272	3161
Pattanur	Rural	1526	6331	3103	3228	553	21	4591	2402	2189	2262	94	4069
Puthurai	Rural	772	3593	1779	1814	2091	0	2333	1297	1036	1567	395	2026
Kadapperikuppam	Rural	462	2028	1021	1007	781	0	1448	802	646	902	309	1126
Mettupalaiyam	Rural	330	1300	656	644	0	0	889	507	382	723	4	577
Thondamanatham	Rural	983	4090	2039	2051	1047	0	2905	1582	1323	1405	389	2685
Ramanathapuram	Rural	703	2841	1406	1435	514	0	1840	1012	828	1204	125	1637
Oussudu	Rural	729	3227	1573	1654	2346	0	2157	1176	981	1179	121	2048
Thuthipet	Rural	230	939	460	479	454	0	695	375	320	389	34	550
Karasur	Rural	397	1752	871	881	822	0	1254	678	576	669	99	1083
Valudavur	Rural	958	4035	2007	2028	1372	0	2656	1439	1217	1729	425	2306
Ottai	Rural	407	1704	862	842	746	20	1082	630	452	898	211	806
Pudupakkam	Rural	327	1310	638	672	452	6	745	416	329	576	1	734
Vanur	Rural	38710	164696	83132	81564	58365	2513	109738	61518	48220	81509	22133	83187
		51146	217822	109699	108123	75979	2965	145815	81504	64311	104407	26509	113415
7-10km													
Kodur	Rural	411	1869	945	924	1377	51	1041	584	457	884	326	985
Appakkam	Rural	160	672	336	336	617	0	456	250	206	377	2	295
Tailapuram	Rural	1101	4388	2206	2182	1404	16	3081	1696	1385	2473	1538	1915
Vilvanatham	Rural	264	1085	554	531	785	51	510	287	223	552	15	533
Mattur	Rural	378	1678	834	844	629	0	998	556	442	867	174	811
Nesal	Rural	354	1566	788	778	692	0	1062	599	463	767	632	799
Bommayapalayam	Rural	2083	8266	4095	4171	614	4	5661	3112	2549	3674	1027	4592
Perambai	Rural	753	3162	1592	1570	924	4	2192	1229	963	1482	579	1680
Poraiyur	Rural	91	378	189	189	197	0	215	113	102	201	6	177
Koodapakkam	Rural	1712	7147	3526	3621	2399	0	4650	2556	2094	2782	312	4365
Ulaivaikkal	Rural	320	1224	623	601	4	0	853	463	390	640	97	584
Agaram (Then)	Rural	110	518	263	255	485	0	361	200	161	294	59	224
Ammanankuppam	Rural	310	1308	643	665	439	0	801	444	357	664	5	644
Ozhukarai (M)	Urban	74133	300104	148464	151640	27366	0	240929	124773	116156	108110	4931	191994
Pillaiyarkuppam	Rural	658	2744	1326	1418	437	0	1848	1011	837	1059	135	1685
Sellipattu	Rural	664	2893	1410	1483	394	0	1978	1077	901	1189	271	1704
Kalithirthalkuppam	Rural	2137	8862	4357	4505	1971	0	6211	3330	2881	3345	818	5517
Pakkiripalayam	Rural	455	1928	971	957	16	0	1385	780	605	842	512	1086
Nerkunam	Rural	320	1367	663	704	938	5	914	507	407	760	429	607
Kaliingamalai	Rural	115	493	259	234	25	0	404	220	184	258	130	235
Muttarampattu	Rural	401	1730	842	888	1300	0	1109	589	520	1030	88	700
Kurampalaiyam	Rural	173	723	362	361	163	0	453	250	203	431	0	292
Vambupet	Rural	269	1111	555	556	162	0	755	412	343	546	32	565
Kodathur	Rural	786	3605	1788	1817	1368	0	2528	1370	1158	1682	825	1923
Suthukeny	Rural	611	2637	1311	1326	1950	0	1593	877	716	1193	37	1444
Sengamedu	Rural	234	1063	521	542	745	35	719	391	328	511	220	552
Kadagampattu	Rural	144	601	315	286	0	0	462	269	193	443	390	158
Kondalamkuppam	Rural	96	353	175	178	97	0	270	144	126	184	7	169
Tollamur	Rural	332	1419	731	688	916	31	826	496	330	637	42	782
Parangani	Rural	773	3393	1684	1709	697	203	2205	1203	1002	1708	651	1685
Semangalam	Rural	863	3635	1859	1776	1361	52	2331	1348	983	1936	582	1699
Kenippattu	Rural	201	943	465	478	426	0	623	340	283	545	293	398
Total		91412	372865	184652	188213	50898	452	289424	151476	137948	142066	15165	230799
Grand Total		146636	607629	302849	304780	131536	3525	447933	239819	208114	253054	42930	354575

ANNEXURE-X

MAJOR INDUSTRIES LOCATED WITHIN THE STUDY AREA

Annexure-IX

List of Major Industries located within the Study Area



Annexure-IX
List of Major Industries located within the Study Area



ANNEXURE-XI

MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheet

Page 1 of 5.

Sodium hydroxide, solid

Section 1 - Chemical Product and Company Identification

MSDS Name: Sodium hydroxide, solid.

Synonyms: Lye, sodium hydrate, white caustic, caustic soda, soda lye, soda ash, ascarite.

Company Identification:

Certified Lye

PO Box 133

Spring Valley, CA 91976-0133

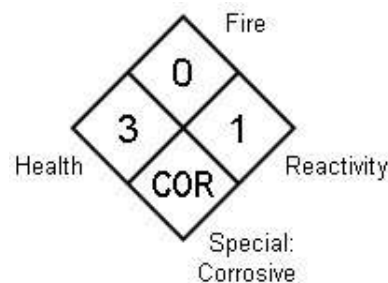
Website: <http://www.certified-lye.com>

Email: info@certified-lye.com

Telephone: 619-548-2378

Poison Control Center: 800-222-1222

Chemtrec: 800-424-9300



Section 2 - Composition, Information on Ingredients

CAS#, Chemical Name, Percent, EINECS/ELINCS:

1310-73-2, Sodium hydroxide, 99-100, 215-185-5.

497-19-8, Sodium carbonate, <1.0, 207-838-8.

Food Chemical Codex (FCC):

These chemicals meet the FDA requirements for food use.

Section 3 - Hazards Identification

Emergency Overview

Appearance: White solid.

Danger! Causes eye and skin burns. Causes digestive and respiratory tract burns. Hygroscopic (absorbs moisture from the air).

Target Organs: Eyes, skin, mucous membranes.

Potential Health Effects

Eye: Causes eye burns. May cause blindness. May cause chemical conjunctivitis and corneal damage.

Skin: Causes skin burns. May cause deep, penetrating ulcers of the skin.

Ingestion: May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the digestive tract. Causes severe pain, nausea, vomiting, diarrhea, and shock.

Inhalation: Irritation may lead to chemical pneumonitis and pulmonary edema. Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. Causes chemical burns to the respiratory tract.

Chronic: Prolonged or repeated skin contact may cause dermatitis. Effects may be delayed.

Section 4 - First Aid Measures

Eyes: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical aid immediately.

Skin: In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Immediately remove contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.

Ingestion: If swallowed, do NOT induce vomiting. Get medical aid immediately. If victim is fully conscious, give a cupful of water. Never give anything by mouth to an unconscious person.

Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician: Treat symptomatically and supportively.

Sodium hydroxide, solid

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Use water spray to keep fire-exposed containers cool. Use water with caution and in flooding amounts. Contact with moisture or water may generate sufficient heat to ignite nearby combustible materials. Contact with metals may evolve flammable hydrogen gas.

Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Do not get water inside containers.

Flammability: Nonflammable.

Flash Point: Not applicable.

Autoignition Temperature: Not applicable.

Flammable Limits: Not available.

NFPA Rating: Health: 3; Flammability: 0; Instability: 1.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Avoid runoff into storm sewers and ditches that lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Avoid generating dusty conditions. Provide ventilation. Do not get water on spilled substances or inside containers.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Do not allow water to get into the container because of violent reaction. Minimize dust generation and accumulation. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Avoid ingestion and inhalation. Discard contaminated shoes. Use only with adequate ventilation.

Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from metals. Keep away from acids. Store protected from moisture. Containers must be tightly closed to prevent the conversion of NaOH to sodium carbonate by the CO₂ in air.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name, ACGIH (TLV), NIOSH (REL), OSHA (PEL):

Sodium hydroxide, 2 mg/m³ Ceiling, 10 mg/m³ Ceiling (15 minutes), 2 mg/m³ TWA. Sodium carbonate, none listed, none listed, none listed.

NIOSH IDLH Concentration: 10 mg/m³.

OSHA Vacated PEL: None of these chemicals have an OSHA Vacated PEL.

Personal Protective Equipment

Eyes: Wear chemical splash goggles and face shield.

Skin: Wear gloves, apron, and/or clothing made of butyl rubber, nitrile rubber, and/or polyethylene.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirator: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Material Safety Data Sheet

Page 3 of 5.

Sodium hydroxide, solid

Section 9 - Physical and Chemical Properties

Physical State: Solid.

Appearance: White pellets.

Odor: Odorless.

pH: 14 (5% aq soln).

Vapor Pressure: 1 mm Hg @ 739 deg C.

Vapor Density: Not available.

Evaporation Rate: Not available.

Viscosity: Not available.

Boiling Point: 1390 deg C @ 760 mm Hg.

Freezing/Melting Point: 318 deg C.

Decomposition Temperature: Not available.

Solubility: Soluble.

Specific Gravity/Density: 2.13 g/cm³.

Molecular Formula: NaOH.

Molecular Weight: 40.00.

Section 10 - Stability and Reactivity

Chemical Stability: Stable at room temperature in closed containers under normal storage and handling conditions.

Conditions to Avoid: Moisture, contact with water, exposure to moist air or water, prolonged exposure to air.

Incompatibilities with Other Materials: Water, metals, acids, aluminum, zinc, tin, nitromethane, leather, flammable liquids, organic halogens, wool.

Hazardous Decomposition Products: Toxic fumes of sodium oxide.

Hazardous Polymerization: Will not occur.

Section 11 - Toxicological Information

NIOSH RTECS#

CAS# 1310-73-2 (sodium hydroxide): WB4900000

CAS# 497-19-8 (sodium carbonate): VZ4050000

LD50/LC50

CAS# 1310-73-2:

Draize test, rabbit, eye: 400 ug Mild;

Draize test, rabbit, eye: 1% Severe;

Draize test, rabbit, eye: 50 ug/24H Severe;

Draize test, rabbit, eye: 1 mg/24H Severe;

Draize test, rabbit, skin: 500 mg/24H Severe.

CAS# 497-19-8:

Draize test, rabbit, eye: 100 mg/24H Moder;

Draize test, rabbit, eye: 50 mg Severe;

Draize test, rabbit, skin: 500 mg/24H Mild;

Inhalation, mouse: LC50 = 1200 mg/m³/2H;

Inhalation, rat: LC50 = 2300 mg/m³/2H;

Oral, mouse: LD50 = 6600 mg/kg;

Oral, mouse: LD50 = 6600 mg/kg;

Oral, rat: LD50 = 4090 mg/kg.

Carcinogenicity

CAS# 1310-73-2: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

CAS# 497-19-8: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information found.

Teratogenicity: No information found.

Reproductive Effects: No information found.

Mutagenicity: See actual entry in RTECS for complete information.

Neurotoxicity: No information found.

Other Studies: No information found.

Section 12 - Ecological Information

No information available.

Sodium hydroxide, solid

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA F List: None of these chemicals are listed in 40 CFR 261.31.

RCRA K List: None of these chemicals are listed in 40 CFR 261.32.

RCRA P List: None of these chemicals are listed in 40 CFR 261.33(e).

RCRA U List: None of these chemicals are listed in 40 CFR 261.33(f).

Section 14 - Transport Information

US DOT, Canada TDG

Shipping Name: Sodium hydroxide, solid; Sodium hydroxide, solid.

Hazard Class: 8, 8.

UN Number: UN1823, UN1823.

Packing Group: II, II.

Section 15 - Regulatory Information

US Federal Regulations

TSCA Section 8(b):

CAS# 1310-73-2 is listed on the TSCA inventory.

CAS# 497-19-8 is listed on the TSCA inventory.

TSCA Section 12(b): None of these chemicals are listed under TSCA Section 12(b).

TSCA Significant New Use Rule: None of these chemicals have a TSCA SNUR.

Chemical Test Rules: None of these chemicals have a Chemical Test Rule.

Health & Safety Reporting List:

None of these chemicals are on the Health & Safety Reporting List.

SARA Title III/EPCRA:

None of these chemicals have a TPQ under EPCRA Section 302 (EHS).

None of these chemicals are reportable under EPCRA Section 304.

None of these chemicals are reportable under EPCRA Section 313.

SARA Codes:

CAS# 1310-73-2: Immediate, reactive.

CAS# 497-19-8: Immediate.

CERCLA Hazardous Substances and Corresponding RQ:

CAS# 1310-73-2: 1000 lb final RQ; 454 kg final RQ.

CAS# 497-19-8: This chemical is not listed and has no RQ.

Clean Air Act:

None of these chemicals are listed under CAA Section 112(r).

None of these chemicals are listed as hazardous air pollutants.

None of these chemicals are listed as Class 1 or Class 2 Ozone Depletors.

Clean Water Act:

CAS# 1310-73-2 is listed as a Hazardous Substance under the CWA Section 311.

None of these chemicals are listed as Priority Pollutants under the CWA Section 303.

None of these chemicals are listed as Toxic Pollutants under the CWA Section 307.

OSHA: None of these chemicals are considered highly hazardous by OSHA.

SARA Title III/EPCRA States' Right-To-Know Lists:

CAS# 1310-73-2 is listed by California, Massachusetts, Minnesota, New Jersey, and Pennsylvania.

CAS# 497-19-8 is not listed by CA, FL, MA, MN, NJ, or PA.

California Prop 65:

None of these chemicals are listed on the California Carcinogenic Chemicals list.

Material Safety Data Sheet

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Sodium hydroxide, solid

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: C.

Risk Phrases:

R 22 (harmful if swallowed),

R 35 (causes severe burns).

Safety Phrases:

S1 (keep locked up),

S2 (keep out of the reach of children),

S26 (in case of contact with eyes, rinse immediately with plenty of water and seek medical advice),

S36 (wear suitable protective clothing),

S37 (wear suitable gloves),

S39 (wear eye/face protection),

S45 (in case of accident or if you feel unwell seek medical advice immediately; show the label where possible).

WGK (Water Danger/Protection):

CAS# 1310-73-2: 1.

CAS# 497-19-8: 1.

Canada – DSL/NDSL:

CAS# 1310-73-2 is listed on Canada's Domestic Substances List.

CAS# 497-19-8 is listed on Canada's Domestic Substances List.

Canada – WHMIS:

This product has a WHMIS classification of E (corrosive material).

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and this MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List:

CAS# 1310-73-2 is listed on the Canadian Ingredient Disclosure List.

CAS# 497-19-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: MAY/04/2006.

Most Recent Revision Date: MAY/1/2013.

Most Recent Revision: Version 4.

Addendum

Safety Precautions for Sodium Hydroxide:

<http://www.certified-lye.com/safety.html>

Protective Equipment for Use with Sodium Hydroxide:

<http://www.certified-lye.com/protect.html>

The information above is believed to be accurate and represents the best information currently available to Certified Lye. However, Certified Lye makes no warranty of merchantability or any other warranty, express or implied, with respect to such information, and Certified Lye assumes no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Certified Lye be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Certified Lye has been advised of the possibility of such damages.

Safety Data Sheet



1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name: **CAUSTIC SODA - LIQUID (46%-50%)**

Other name(s): Sodium hydroxide - liquid (46%-50%), Soda lye solution (46%-50%), Caustic soda solution (46%-50%), Sodium hydroxide solution (46%-50%), Liquid caustic soda (46%-50%), LCS 46%, Rezolv 46, Algane C46, Rezolv 50.

Recommended use of the chemical and restrictions on use: Chemical manufacture; neutralising agent; pulp and paper, aluminium, detergent, and textile processing; vegetable oil refining; reclaiming rubber; etching and electroplating; food additive.

Supplier: Ixom Operations Pty Ltd
ABN: 51 600 546 512
Street Address: Level 8, 1 Nicholson Street
Melbourne 3000
Australia

Telephone Number: +61 3 9665 7111
Facsimile: +61 3 9665 7937
Emergency Telephone: **1 800 033 111 (ALL HOURS)**

Please ensure you refer to the limitations of this Safety Data Sheet as set out in the "Other Information" section at the end of this Data Sheet.

2. HAZARDS IDENTIFICATION

Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail; DANGEROUS GOODS.

This material is hazardous according to Safe Work Australia; HAZARDOUS SUBSTANCE.

Classification of the substance or mixture:

Corrosive to Metals - Category 1
Skin Corrosion - Sub-category 1A
Eye Damage - Category 1

SIGNAL WORD: DANGER



Hazard Statement(s):

H290 May be corrosive to metals.
H314 Causes severe skin burns and eye damage.

Precautionary Statement(s):

Prevention:

P234 Keep only in original container.
P260 Do not breathe dust / fume / gas / mist / vapours / spray.
P264 Wash hands thoroughly after handling.
P280 Wear protective gloves / protective clothing / eye protection / face protection.

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**Response:**

P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P363 Wash contaminated clothing before re-use.
P304+P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P310 Immediately call a POISON CENTER or doctor/physician.
P321 Specific treatment (see First Aid Measures on Safety Data Sheet).
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P390 Absorb spillage to prevent material damage.

Storage:

P405 Store locked up.
P406 Store in corrosive resistant container with a resistant inner liner.

Disposal:

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

Poisons Schedule (SUSMP): S6 Poison.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Proportion	Hazard Codes
Sodium hydroxide	1310-73-2	46-50%	H290 H314 H318
Water	7732-18-5	50-54%	-

4. FIRST AID MEASURES

For advice, contact a Poisons Information Centre (e.g. phone Australia 131 126; New Zealand 0800 764 766) or a doctor.

Inhalation:

Remove victim from area of exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. For all but the most minor symptoms arrange for patient to be seen by a doctor as soon as possible, either on site or at the nearest hospital.

Skin Contact:

If spilt on large areas of skin or hair, immediately drench with running water and remove clothing. Continue to wash skin and hair with plenty of water (and soap if material is insoluble) until advised to stop by the Poisons Information Centre or a doctor.

Eye Contact:

If in eyes, hold eyelids apart and flush the eye continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre or a doctor, or for at least 15 minutes.

Ingestion:

Immediately rinse mouth with water. If swallowed, do NOT induce vomiting. Give a glass of water. Seek immediate medical assistance.

Indication of immediate medical attention and special treatment needed:

Treat symptomatically. Can cause corneal burns.

5. FIRE FIGHTING MEASURES

Product Name: CAUSTIC SODA - LIQUID (46%-50%)
Substance No: 000031006701

Issued: 11/05/2015
Version: 6

Safety Data Sheet

**Suitable Extinguishing Media:**

Not combustible, however, if material is involved in a fire use: Fine water spray, normal foam, dry agent (carbon dioxide, dry chemical powder).

Hazchem or Emergency Action Code: 2R

Specific hazards arising from the substance or mixture:

Non-combustible material.

Special protective equipment and precautions for fire-fighters:

Not combustible, however following evaporation of aqueous component residual material can decompose if involved in a fire, emitting toxic fumes. Contact with metals may liberate hydrogen gas which is extremely flammable. Fire fighters to wear self-contained breathing apparatus and suitable protective clothing if risk of exposure to products of decomposition.

6. ACCIDENTAL RELEASE MEASURES

Emergency procedures/Environmental precautions:

Clear area of all unprotected personnel. If contamination of sewers or waterways has occurred advise local emergency services.

Personal precautions/Protective equipment/Methods and materials for containment and cleaning up:

Slippery when spilt. Avoid accidents, clean up immediately. Wear protective equipment to prevent skin and eye contact and breathing in vapours. Work up wind or increase ventilation. Contain - prevent run off into drains and waterways. Use absorbent (soil, sand or other inert material). Collect and seal in properly labelled containers or drums for disposal. Caution - heat may be evolved on contact with water.

7. HANDLING AND STORAGE

This material is a Scheduled Poison S6 and must be stored, maintained and used in accordance with the relevant regulations.

Precautions for safe handling:

Avoid skin and eye contact and breathing in vapour, mists and aerosols.

Conditions for safe storage, including any incompatibilities:

Store in cool place and out of direct sunlight. Store away from incompatible materials described in Section 10. Store away from foodstuffs. Do not store in aluminium or galvanised containers nor use die-cast zinc or aluminium bungs; plastic bungs should be used. At temperatures greater than 40°C, tanks must be stress relieved. Keep containers closed when not in use - check regularly for leaks.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters: No value assigned for this specific material by Safe Work Australia. However, Workplace Exposure Standard(s) for constituent(s):

Sodium hydroxide: Peak Limitation = 2 mg/m³

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As published by Safe Work Australia Workplace Exposure Standards for Airborne Contaminants.

Peak Limitation - a maximum or peak airborne concentration of a particular substance determined over the shortest analytically practicable period of time which does not exceed 15 minutes.

These Workplace Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These workplace exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Appropriate engineering controls:

Ensure ventilation is adequate to maintain air concentrations below Workplace Exposure Standards. Keep containers closed when not in use.

If in the handling and application of this material, safe exposure levels could be exceeded, the use of engineering controls such as local exhaust ventilation must be considered and the results documented. If achieving safe exposure levels does not require engineering controls, then a detailed and documented risk assessment using the relevant Personal Protective Equipment (PPE) (refer to PPE section below) as a basis must be carried out to determine the minimum PPE requirements.

Individual protection measures, such as Personal Protective Equipment (PPE):

The selection of PPE is dependent on a detailed risk assessment. The risk assessment should consider the work situation, the physical form of the chemical, the handling methods, and environmental factors.

OVERALLS, CHEMICAL GOGGLES, FACE SHIELD, GLOVES (Long), APRON, RUBBER BOOTS.



Wear overalls, chemical goggles, face shield, elbow-length impervious gloves, splash apron or equivalent chemical impervious outer garment, and rubber boots. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

If determined by a risk assessment an inhalation risk exists, wear a suitable mist respirator meeting the requirements of AS/NZS 1715 and AS/NZS 1716.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Liquid
Colour:	Colourless to Slightly Coloured
Solubility:	Miscible with water.
Specific Gravity:	1.48-1.52 @20°C
Relative Vapour Density (air=1):	Not available
Vapour Pressure (20 °C):	1.34 mm Hg (calculated)
Flash Point (°C):	Not applicable
Flammability Limits (%):	Not applicable
Autoignition Temperature (°C):	Not applicable
Boiling Point/Range (°C):	ca. 145 (literature)
pH:	14 (literature)
Freezing Point/Range (°C):	ca. 12 (calculated)

Product Name: CAUSTIC SODA - LIQUID (46%-50%)
Substance No: 000031006701

Issued: 11/05/2015
Version: 6

10. STABILITY AND REACTIVITY

Reactivity:	Reacts violently with acids. Reacts exothermically on dilution with water.
Chemical stability:	Stable under normal ambient and anticipated storage and handling conditions of temperature and pressure. Absorbs carbon dioxide from the air.
Possibility of hazardous reactions:	Reacts with ammonium salts, evolving ammonia gas. Reacts readily with various reducing sugars (i.e. fructose, galactose, maltose, dry whey solids) to produce carbon monoxide. Take precautions including monitoring the tank atmosphere for carbon monoxide to ensure safety of personnel before vessel entry.
Conditions to avoid:	Avoid exposure to moisture.
Incompatible materials:	Incompatible with ammonium salts , aluminium , tin , and zinc .
Hazardous decomposition products:	None known.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Ingestion:	Swallowing can result in nausea, vomiting, diarrhoea, abdominal pain and chemical burns to the gastrointestinal tract.
Eye contact:	A severe eye irritant. Corrosive to eyes; contact can cause corneal burns. Contamination of eyes can result in permanent injury.
Skin contact:	Contact with skin will result in severe irritation. Corrosive to skin - may cause skin burns.
Inhalation:	Breathing in mists or aerosols may produce respiratory irritation.
Acute toxicity:	No LD50 data available for the product. For the constituent Sodium hydroxide :
Skin corrosion/irritation:	Severe irritant (rabbit).
Chronic effects:	No information available for the product.

12. ECOLOGICAL INFORMATION

Ecotoxicity	Avoid contaminating waterways.

13. DISPOSAL CONSIDERATIONS

Disposal methods:
Refer to Waste Management Authority. Dispose of contents/container in accordance with local/regional/national/international regulations.

14. TRANSPORT INFORMATION

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Road and Rail Transport

Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail; DANGEROUS GOODS.



UN No: 1824
Transport Hazard Class: 8 Corrosive
Packing Group: II
Proper Shipping Name or Technical Name: SODIUM HYDROXIDE SOLUTION
Hazchem or Emergency Action Code: 2R

Marine Transport

Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea; DANGEROUS GOODS.

UN No: 1824
Transport Hazard Class: 8 Corrosive
Packing Group: II
Proper Shipping Name or Technical Name: SODIUM HYDROXIDE SOLUTION

IMDG EMS Fire: F-A
IMDG EMS Spill: S-B

Air Transport

Classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air; DANGEROUS GOODS.

UN No: 1824
Transport Hazard Class: 8 Corrosive
Packing Group: II
Proper Shipping Name or Technical Name: SODIUM HYDROXIDE SOLUTION

15. REGULATORY INFORMATION

Classification:

This material is hazardous according to Safe Work Australia; HAZARDOUS SUBSTANCE.

Classification of the substance or mixture:

Corrosive to Metals - Category 1
Skin Corrosion - Sub-category 1A
Eye Damage - Category 1

Hazard Statement(s):

H290 May be corrosive to metals.
H314 Causes severe skin burns and eye damage.

Poisons Schedule (SUSMP): S6 Poison.

Product Name: CAUSTIC SODA - LIQUID (46%-50%)
Substance No: 000031006701

Issued: 11/05/2015
Version: 6

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All the constituents of this material are listed on the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

`Registry of Toxic Effects of Chemical Substances'. Ed. D. Sweet, US Dept. of Health & Human Services: Cincinnati, 2014.

This safety data sheet has been prepared by Ixom Operations Pty Ltd Toxicology & SDS Services.

Reason(s) for Issue:

Change in company details

This SDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Ixom Operations Pty Ltd cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact their Ixom representative or Ixom Operations Pty Ltd at the contact details on page 1.

Ixom Operations Pty Ltd's responsibility for the material as sold is subject to the terms and conditions of sale, a copy of which is available upon request.

Material Safety Data Sheet

Linear Alkyl Benzene

1. Chemical Product and Company Information :

- Trade name: Linear Alkyl Benzene.
- Synonyms: Benzene C10-C13 alkyl Derivatives / LAB
- CAS Number : 67774-74-7
- Manufacture : SEEF LIMITED QATAR
P.O.Box# 50077 - Mesaieed , Qatar
Tel.: +974-44223562 - Fax: +974-40139525
www.seef.com.qa

2. Hazard Identification:

- **Health Hazard:**
NFPA Rating: 1 HMIS Rating: 1
- **Flammability Hazard:**
NFPA Rating: 1 HMIS Rating: 1
- **Reactivity Hazard:**
NFPA Rating: 0 HMIS Rating: 0
- **Environmental Hazard:**
Not applicable.

3. First Aid:

- **Eye:** Flush eyes with water for at least 15 minutes.
- **Skin:** Wash the skin with soap and water, If irritation persists get medical attention.
- **Inhalation:** Remove to fresh air and train people give CPR, get Medical attention if required.
- **Ingestion:** Do not induce vomiting, Get Medical attention.

4. Fire fighting measures:

- **Extinguishing Media:** CO₂, dry Chemical powder and foam.
- **Fire Data:** Flash point 130 °C
- **Combustible products:** CO and CO₂

5. Accidental release measures:

- Person-related safety precautions Wear protective clothing and equipment. Isolate hazard area. Evacuate all unauthorized personnel not participating in rescue operations from the area. Avoid entry into danger area. Remove all possible sources of ignition. Stop traffic and switch off the motors of the engines. Do not smoke and do not handle with naked flame. Use explosion-proof lamps and non-sparking tools. Avoid contact with the substance.
- Precautions for protection of the environment: Prevent from further leaks of substance. Dike flow of spilled material using soil or sandbags to minimize

contamination of drains, surface and ground waters. If Linear Alkyl Benzene has flowed into drains, ponds or sewage systems, inform appropriate authority.

- Recommended methods for cleaning and disposal: Soak up residues with non-combustible absorbent material (e.g. sand, earth, vermiculite) and forward for disposal in closed containers. Dispose off under valid legal waste regulations.

6. Handling and storage:

- Handling in accordance with good hygiene and safety procedures, since empty containers contain residue, follow all hazard warning and precautions.
- Store in a cool, dry and well ventilated area. Store separately from combustible, organic and oxidizable materials.

7. Exposure control:

Personal protective equipment (PPE) for the protection of eyes, hands and skin corresponding with the performed labor has to be kept at disposition for the employees. All PPE have to be kept in disposable state and the damaged or contaminated equipment has to be replaced immediately.

- **Eye:** Use chemical safety goggles.
- **Skin:** Wear impervious protective clothing, including boots, gloves and coveralls.
- **Respiratory protection:** If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-face piece respirator, airline hood, or full face piece self-contained breathing apparatus.
- **Environmental exposure controls:** Proceed in accordance with valid air and water legislative regulations.

8. Physical and chemical properties:

Physical State: Liquid	Appearance: Colorless
Odor: Odorless	pH: Not Applicable
Boiling Range: 270 – 320 °C	Flash Pint: 130 °C
Flammability: Not Available	Explosive properties: Not Applicable
Oxidizing properties: Not Available	Freezing Point: 4 °C
Vapor pressure mm Hg @ 20 °C: <0.1	Water Solubility: Negligible
Viscosity: 5- 10 cps @ 20 °C	Vapor Density: 8.4
Specific Gravity: 0.86	

9. Stability and reactivity:

Stable. Incompatible with strong oxidizers and No dangerous polymerization.

10. Disposal:

Waste can be incinerated under controlled conditions or land filled according to official regulations.

This information contained herein has been compiled from sources considered by SEEF Limited to be dependable and is accurate to the best of the company's knowledge. The information relates to the specific products designated herein, and does not relate to use in combination with any other material of any other process. SEEF Limited disclaims any liability for injury to the recipient or third persons or for any damage to any property resulting on misuses of the controlled product.

Safety Data Sheet

SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product Identifier

Material Name : Alkylate

1.2 Relevant identified uses of the substance or mixture and uses advised against

Product Use : For use as a component in gasoline. Feedstock in chemical industry. Refinery Feedstock. Please refer to Ch16 and/or the annexes for the registered uses under REACH.

Uses Advised Against : This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.

1.3 Details of the Supplier of the safety data sheet

Manufacturer/Supplier : Shell Trading Rotterdam B.V.
Weena 70
3012 CM Rotterdam
Netherlands

Telephone : +31 10 441 5000
**Email Contact for
Safety Data Sheet** : TRsds@shell.com

1.4 Emergency Telephone Number

: +44 151 350 4595 National Poison Information Centre
(NVIC): Tel. nr. +31 30 - 2748888 (24 hrs a day and 7 days a week).
Only for the purpose of informing medical personnel in cases of accidental intoxications

SECTION 2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Regulation (EC) No 1272/2008 (CLP)	
Hazard classes / Hazard categories	Hazard Statement
Flammable liquids, Category 2	H225

Safety Data Sheet

Skin corrosion/irritation, Category 2	H315
Aspiration hazard, Category 1	H304
Specific target organ toxicity - single exposure, Category 3; Inhalation; Narcotic effects.	H336
Hazardous to the aquatic environment - Long-term Hazard, Category 2	H411

67/548/EEC or 1999/45/EC	
Hazard Characteristics	R-phrases(s)
F: Highly flammable.; Xi: Irritant.; Xn: Harmful.; N: Dangerous for the environment.;	R11; R38; R65; R67; R51/53

Classification triggering components : Contains Low boiling point naphtha.

2.2 Label Elements

Labeling according to Regulation (EC) No 1272/2008

Hazard pictograms :



Signal Words : Danger

CLP Hazard Statements : PHYSICAL HAZARDS:
H225: Highly flammable liquid and vapour.

HEALTH HAZARDS:
H315: Causes skin irritation.
H304: May be fatal if swallowed and enters airways.
H336: May cause drowsiness or dizziness.

ENVIRONMENTAL HAZARDS:
H411: Toxic to aquatic life with long lasting effects.

CLP Precautionary statements

Prevention : P201: Obtain special instructions before use.
P210: Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P280: Wear protective gloves/protective clothing/eye

Safety Data Sheet

protection/face protection.

- Response** : P301+P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
- Storage** : P403+P233: Store in a well-ventilated place. Keep container tightly closed.
- Disposal:** : P501: Dispose of contents and container to appropriate waste site or reclaimer in accordance with local and national regulations.

2.3 Other Hazards

- Health Hazards** : Slightly irritating to respiratory system.

- Safety Hazards** : This material is a static accumulator. Even with proper grounding and bonding, this material can still accumulate an electrostatic charge. If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur. Liquid evaporates quickly and can ignite leading to a flash fire, or an explosion in a confined space.

- Other Information** : This product is intended for use in closed systems only.

The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substance

- Material Name** : Not applicable.

3.2 Mixtures

Hazardous Components

Safety Data Sheet

Classification of components according to Regulation (EC) No 1272/2008

Chemical Name	CAS No.	EC Number	REACH Registration No.	Conc.
Naphtha (petroleum), full-range alkylate	64741-64-6	265-066-7	01-2119485026-38	0,00 - 100,00%
Naphtha (petroleum), light alkylate	64741-66-8	265-068-8	01-2119463272-43	0,00 - 100,00%
Naphtha (petroleum), full-range alkylate, butane-contg.	68527-27-5	271-267-0	01-2119471477-29	0,00 - 100,00%

Chemical Name	Hazard Class & Category	Hazard Statement
Naphtha (petroleum), full-range alkylate	Flam. Liq., 2; Skin Corr., 2; Asp. Tox., 1; STOT SE, 3; Aquatic Chronic, 2;	H225; H315; H304; H336; H411;
Naphtha (petroleum), light alkylate	Flam. Liq., 2; Skin Corr., 2; Asp. Tox., 1; STOT SE, 3; Aquatic Chronic, 2;	H225; H315; H304; H336; H411;
Naphtha (petroleum), full-range alkylate, butane-contg.	Flam. Liq., 2; Skin Corr., 2; Asp. Tox., 1; STOT SE, 3; Aquatic Chronic, 2;	H225; H315; H304; H336; H411;

Classification of components according to 67/548/EEC

Chemical Name	CAS No.	EC Number	REACH Registration No.	Symbol(s)	R-phrases(s)	Conc.
Naphtha (petroleum), full-range alkylate	64741-64-6	265-066-7	01-2119485026-38	F, Xi, Xn, N	R11; R38; R65; R67; R51/53	0,00 - 100,00%
Naphtha (petroleum), light alkylate	64741-66-8	265-068-8	01-2119463272-43	F, Xi, Xn, N	R11; R38; R65; R67; R51/53	0,00 - 100,00%
Naphtha (petroleum), full-range alkylate, butane-contg.	68527-27-5	271-267-0	01-2119471477-29	F, Xi, Xn, N	R11; R38; R65; R67; R51/53	0,00 - 100,00%

Additional Information : Refer to Ch 16 for full text of R- and H- phrases.

The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.

Safety Data Sheet

Contains 2,2,4 Trimethylpentane, CAS # 540-84-1 Contains
2,3,4 Trimethylpentane, CAS # 565-75-3 Contains Benzene,
CAS # 71-43-2. Contains n-Hexane, CAS # 110-54-3.
Contains Toluene, CAS # 108-88-3.

SECTION 4. FIRST-AID MEASURES

4.1 Description of First Aid Measures

Inhalation	:	Remove to fresh air. If rapid recovery does not occur, transport to nearest medical facility for additional treatment.
Skin Contact	:	Remove contaminated clothing. Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment.
Eye Contact	:	Flush eyes with water while holding eyelids open. Rest eyes for 30 minutes. If redness, burning, blurred vision, or swelling persist transport to the nearest medical facility for additional treatment.
Ingestion	:	If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. If any of the following delayed signs and symptoms appear within the next 6 hours, transport to the nearest medical facility: fever greater than 101° F (38.3°C), shortness of breath, chest congestion or continued coughing or wheezing.
Self-protection of the first aider	:	When administering first aid, ensure that you are wearing the appropriate personal protective equipment according to the incident, injury and surroundings.
4.2 Most important symptoms and effects, both acute and delayed	:	Skin irritation signs and symptoms may include a burning sensation, redness, swelling, and/or blisters. Eye irritation signs and symptoms may include a burning sensation and a temporary redness of the eye. If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure.
4.3 Indication of any immediate medical attention and special treatment needed	:	Treat symptomatically.

SECTION 5. FIRE-FIGHTING MEASURES

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Clear fire area of all non-emergency personnel.

- 5.1 Extinguishing Media** : Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
- Unsuitable Extinguishing Media** : Do not use direct water jets on the burning product as they could cause a steam explosion and spread of the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.
- 5.2 Special hazards arising from the substance or mixture** : Carbon monoxide may be evolved if incomplete combustion occurs. Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Unidentified organic and inorganic compounds. The vapour is heavier than air, spreads along the ground and distant ignition is possible. Will float and can be reignited on surface water.
- 5.3 Advice for firefighters** : Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).
- Additional Advice** : If the fire cannot be extinguished the only course of action is to evacuate immediately. Keep adjacent containers cool by spraying with water. If possible remove containers from the danger zone. Contain residual material at affected sites to prevent material from entering drains (sewers), ditches, and waterways.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Observe the relevant local and international regulations. Avoid contact with skin, eyes and clothing. Evacuate the area of all non-essential personnel. Ventilate contaminated area thoroughly. Avoid contact with spilled or released material. Immediately remove all contaminated clothing. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet. If contamination of sites occurs remediation may require specialist advice. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Take precautionary measures against static discharges.

- 6.1 Personal Precautions, Protective Equipment and Emergency Procedures** :
- 6.1.1 For non emergency personnel: Do not breathe fumes, vapour. Do not operate electrical equipment.
- 6.1.2 For emergency responders: Shut off leaks, if possible without personal risks. Remove all possible sources of ignition

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	in the surrounding area and evacuate all personnel. Attempt to disperse the gas or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Monitor area with combustible gas meter. Vapour can travel for considerable distances both above and below the ground surface. Underground services (drains, pipelines, cable ducts) can provide preferential flow paths.
6.2 Environmental Precautions	: Take measures to minimise the effects on groundwater. Prevent from spreading or entering into drains, ditches or rivers by using sand, earth, or other appropriate barriers. Contain residual material at affected sites to prevent material from entering drains (sewers), ditches, and waterways.
6.3 Methods and Material for Containment and Cleaning Up	: Take precautionary measures against static discharges. For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely.
Additional Advice	: Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. Local authorities should be advised if significant spillages cannot be contained. Maritime spillages should be dealt with using a Shipboard Oil Pollution Emergency Plan (SOPEP), as required by MARPOL Annex 1 Regulation 26.
6.4 Reference to other sections	: For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet.

SECTION 7. HANDLING AND STORAGE

General Precautions	: Avoid breathing vapours or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of

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- local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material. Air-dry contaminated clothing in a well-ventilated area before laundering. Prevent spillages. Do not use as a cleaning solvent or other non-motor fuel uses. Contaminated leather articles including shoes cannot be decontaminated and should be destroyed to prevent reuse.
- 7.1 Precautions for Safe Handling** : When using do not eat or drink. Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks. Never siphon by mouth. The vapour is heavier than air, spreads along the ground and distant ignition is possible. Avoid exposure. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols.
- Product Transfer** : Wait 2 minutes after tank filling (for tanks such as those on road tanker vehicles) before opening hatches or manholes. Wait 30 minutes after tank filling (for large storage tanks) before opening hatches or manholes. Even with proper grounding and bonding, this material can still accumulate an electrostatic charge. If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur. Be aware of handling operations that may give rise to additional hazards that result from the accumulation of static charges. These include but are not limited to pumping (especially turbulent flow), mixing, filtering, splash filling, cleaning and filling of tanks and containers, sampling, switch loading, gauging, vacuum truck operations, and mechanical movements. These activities may lead to static discharge e.g. spark formation. Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (≤ 1 m/s until fill pipe submerged to twice its diameter, then ≤ 7 m/s). Avoid splash filling. Do NOT use compressed air for filling, discharging, or handling operations.
- 7.2 Conditions for safe storage, including any incompatibilities** : Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Cleaning, inspection and maintenance of storage tanks is a specialist operation, which requires the implementation of strict procedures and precautions. Keep in a cool place. Electrostatic charges will be generated during pumping. Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment to reduce the risk. The vapours in the head space of the storage vessel may

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- lie in the flammable/explosive range and hence may be flammable. Refer to section 15 for any additional specific legislation covering the packaging and storage of this product.
- Recommended Materials** : For containers, or container linings use mild steel, stainless steel. Examples of suitable materials are: high density polyethylene (HDPE), polypropylene (PP), and Viton (FKM), which have been specifically tested for compatibility with this product. For container linings, use amine-adduct cured epoxy paint. For seals and gaskets use: graphite, PTFE, Viton A, Viton B.
- Unsuitable Materials** : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene. However, some may be suitable for glove materials.
- Container Advice** : Do not cut, drill, grind, weld or perform similar operations on or near containers. Containers, even those that have been emptied, can contain explosive vapours.
- 7.3 Specific end use(s)** : Please refer to Ch16 and/or the annexes for the registered uses under REACH.
See additional references that provide safe handling practices for liquids that are determined to be static accumulators: American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practices on Static Electricity). CENELEC CLC/TR 50404 (Electrostatics – Code of practice for the avoidance of hazards due to static electricity).
- Additional Information** : Ensure that all local regulations regarding handling and storage facilities are followed.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

Read in conjunction with the Exposure Scenario for your specific use contained in the Annex.

8.1 Control Parameters

Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation

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2,2,4 Trimethylpentane	ACGIH	TWA	300 ppm		
2,3,4 Trimethylpentane	ACGIH	TWA	300 ppm		
n-hexane	ACGIH	TWA	50 ppm		
	ACGIH	SKIN_DES			Can be absorbed through the skin.
	NL OEL	TGG		72 mg/m3	
	NL OEL	TGG 15		144 mg/m3	
Benzene	ACGIH	TWA	0,5 ppm		
	ACGIH	STEL	2,5 ppm		
	ACGIH	SKIN_DES			Can be absorbed through the skin.
	SHELL IS	TWA	0,5 ppm	1,6 mg/m3	
	SHELL IS	STEL	2,5 ppm	8 mg/m3	
	NL OEL	TGG		3,25 mg/m3	Section B: List of Carcinogens
	NL OEL	SKIN_DES			Can be absorbed through the skin.
Toluene	ACGIH	TWA	20 ppm		
	NL OEL	TGG		150 mg/m3	
	NL OEL	TGG 15		384 mg/m3	

Additional Information : SHELL IS is the Shell Internal Standard. Skin notation means that significant exposure can also occur by absorption of liquid

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through the skin and of vapour through the eyes or mucous membranes.

Biological Exposure Index (BEI)

Material	Determinant	Sampling Time	BEI	Reference
Benzene	t,t-Muconic acid in Creatinine in urine	Sampling time: End of shift.	500 µg/g	ACGIH BEL (2011)
	S-Phenylmercapturic acid in Creatinine in urine	Sampling time: End of shift.	25 µg/g	ACGIH BEL (2011)
n-hexane	2,5-Hexanedion, without hydrolysis in Urine	Sampling time: End of shift at end of work week.	0,4 mg/l	ACGIH BEL (2011)
Toluene	o-Cresol, with hydrolysis in Creatinine in urine	Sampling time: End of shift.	0,3 mg/g	ACGIH BEL (2011)
	toluene in Blood	Sampling time: Prior to last shift of work week.	0,02 mg/l	ACGIH BEL (2011)
	toluene in Urine	Sampling time: End of shift.	0,03 mg/l	ACGIH BEL (2011)

Derived No Effect Levels (DNEL/DMEL) Table

Component	Exposure Route	Exposure Type (long/short)	Application Area	Value

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Naphtha (petroleum), full-range alkylate	Inhalation	acute, systemic effects	Worker	1300 mg/m3/15 mins
	Inhalation	acute, systemic effects	Consumer	1200 mg/m3/15 mins
Naphtha (petroleum), light alkylate	Inhalation	acute, systemic effects	Worker	1300 mg/m3/15 mins
	Inhalation	acute, systemic effects	Consumer	1200 mg/m3/15 mins
Naphtha (petroleum), full-range alkylate, butane-contg.	Inhalation	acute, systemic effects	Worker	1300 mg/m3/15 mins
	Inhalation	acute, systemic effects	Consumer	1200 mg/m3/15 mins

PNEC related information : Substance is a hydrocarbon with a complex, unknown or variable composition. Conventional methods of deriving PNECs are not appropriate and it is not possible to identify a single representative PNEC for such substances.

Monitoring Methods : Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate. Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory. Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available.
National Institute of Occupational Safety and Health (NIOSH), USA: Manual of Analytical Methods <http://www.cdc.gov/niosh/>
Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods <http://www.osha.gov/>

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8.2 Exposure Controls General Information

: The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Use sealed systems as far as possible. Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits. Local exhaust ventilation is recommended. Eye washes and showers for emergency use. Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping. Define procedures for safe handling and maintenance of controls. Educate and train workers in the hazards and control measures relevant to normal activities associated with this product. Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation. Firewater monitors and deluge systems are recommended.

Do not ingest. If swallowed then seek immediate medical assistance.

Drain down system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle.

Occupational Exposure Controls

Personal Protective Equipment

: Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

The provided information is made in consideration of the PPE directive (Council Directive 89/686/EEC) and the CEN European Committee for Standardisation (CEN) standards.

Eye Protection

: Chemical splash goggles (chemical monogoggles). If a local risk assessment deems it so, then chemical splash goggles may not be required and safety glasses may provide adequate eye protection.

Approved to EU Standard EN166.

Hand Protection

: Personal hygiene is a key element of effective hand care.

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Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same, but recognise that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time may be acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material. Select gloves tested to a relevant standard (e.g. Europe EN374, US F739). When prolonged or frequent repeated contact occurs, Nitrile gloves may be suitable. (Breakthrough time of > 240 minutes.) For incidental contact/splash protection Neoprene, PVC gloves may be suitable.

Body protection : Chemical resistant gloves/gauntlets, boots, and apron (where risk of splashing).

Respiratory Protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. All respiratory protection equipment and use must be in accordance with local regulations. Select a filter suitable for combined particulate/organic gases and vapors [Type A/Type P boiling point > 65°C (149°F)] meeting EN14387 and EN143.

Thermal Hazards : Not applicable.

Environmental Exposure Controls

Environmental exposure control measures : Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.

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Information on accidental release measures are to be found in section 6.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	: Pale yellow. Straw. Liquid.
Odour	: Hydrocarbon.
Odour threshold	: Data not available
pH	: Not applicable.
Initial Boiling Point and Boiling Range	: 90 - 220 °C / 194 - 428 °F
Melting / freezing point	: Not applicable.
Flash point	: < 0 °C / 32 °F
Upper / lower Flammability or Explosion limits	: 1,4 - 7,6 %(V)
Ignition temperature	: 275 - 445 °C / 527 - 833 °F
Vapour pressure	: 300 - 500 hPa at 38 °C / 100 °F
Relative Density	: Data not available
Density	: 0,695 - 0,710 g/cm ³ at 15 °C / 59 °F
Water solubility	: Not applicable
Solubility in other solvents	: Data not available
n-octanol/water partition coefficient (log Pow)	: Not applicable.
Kinematic viscosity	: 0,5 mm ² /s at 40 °C / 104 °F
Vapour density (air=1)	: Data not available
Decomposition Temperature	: Data not available
Flammability	: Not applicable.
Oxidizing Properties	: Not applicable.
Explosive Properties	: Not classified

9.2 Other Information

Electrical conductivity	: Low conductivity: < 100 pS/m, The conductivity of this material makes it a static accumulator., A liquid is typically considered nonconductive if its conductivity is below 100 pS/m and is considered semi-conductive if its conductivity is below 10 000 pS/m., Whether a liquid is nonconductive or semi-conductive, the precautions are the same., A number of factors, for example liquid temperature, presence of contaminants, and anti-static additives can greatly influence the conductivity of a liquid.

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Low conductivity: < 100 pS/m, The conductivity of this material makes it a static accumulator., A liquid is typically considered nonconductive if its conductivity is below 100 pS/m and is considered semi-conductive if its conductivity is below 10 000 pS/m., Whether a liquid is nonconductive or semi-conductive, the precautions are the same., A number of factors, for example liquid temperature, presence of contaminants, and anti-static additives can greatly influence the conductivity of a liquid.

Other Information : Not applicable.

SECTION 10. STABILITY AND REACTIVITY

- 10.1 Reactivity** : May oxidise in the presence of air.
- 10.2 Chemical stability** : Stable under normal conditions of use.
- 10.3 Possibility of Hazardous Reactions** : May oxidise in the presence of air.
- 10.4 Conditions to Avoid** : Avoid heat, sparks, open flames and other ignition sources.
- 10.5 Incompatible Materials** : Strong oxidising agents.
- 10.6 Hazardous Decomposition Products** : Hazardous decomposition products are not expected to form during normal storage. Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation.
- Sensitivity to Static Discharge** : Yes, in certain circumstances product can ignite due to static electricity.

SECTION 11. TOXICOLOGICAL INFORMATION

11.1 Information on Toxicological effects

- Basis for Assessment** : Information given is based on product data, a knowledge of the components and the toxicology of similar products.
- Likely Routes of Exposure** : Exposure may occur via inhalation, ingestion, skin absorption, skin or eye contact, and accidental ingestion.
- Acute Oral Toxicity** : Low toxicity: LD50 > 5000 mg/kg , Rat
- Acute Dermal Toxicity** : Low toxicity: LD50 >2000 mg/kg , Rabbit
- Acute Inhalation Toxicity** : Low toxicity: LC50 >5 mg/l / 4,00 h, Rat

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Skin corrosion/irritation	: Low toxicity by inhalation. LC50 >5 mg/l / 4,00 h, Rat
Serious eye damage/irritation	: Irritating to skin.
Respiratory Irritation	: Expected to be slightly irritating.
Respiratory or skin sensitisation	: Based on human experience, breathing of vapours or mists may cause a temporary burning sensation to nose, throat and lungs.
Aspiration Hazard	: Not expected to be a sensitiser.
Germ cell mutagenicity	: Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.
Carcinogenicity	: Not expected to be mutagenic.
	: Not expected to be carcinogenic.

Material		Carcinogenicity Classification
Naphtha (petroleum), full-range alkylate	:	GHS / CLP: No carcinogenicity classification
Naphtha (petroleum), light alkylate	:	GHS / CLP: No carcinogenicity classification
Naphtha (petroleum), full-range alkylate, butane-contg.	:	GHS / CLP: No carcinogenicity classification
2,2,4 Trimethylpentane	:	GHS / CLP: No carcinogenicity classification
2,3,4 Trimethylpentane	:	GHS / CLP: No carcinogenicity classification
n-hexane	:	GHS / CLP: No carcinogenicity classification
Benzene	:	ACGIH Group A1: Confirmed human carcinogen.
Benzene	:	NTP: Known To Be Human Carcinogen.
Benzene	:	IARC 1: Carcinogenic to humans.
Benzene	:	GHS / CLP: Carcinogenicity Category 1A
Toluene	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Toluene	:	IARC 3: Not classifiable as to carcinogenicity to humans.
Toluene	:	GHS / CLP: No carcinogenicity classification

Reproductive and Developmental Toxicity	: Not expected to be a developmental toxicant. Not expected to impair fertility.

Summary on evaluation of the CMR properties

Carcinogenicity	: This product does not meet the criteria for classification in categories 1A/1B.,
Mutagenicity	: This product does not meet the criteria for classification in categories 1A/1B.
Reproductive Toxicity	: This product does not meet the criteria for classification in

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(fertility)	categories 1A/1B.
Specific target organ toxicity - single exposure	: High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.
Specific target organ toxicity - repeated exposure	: Expected to have low toxicity on repeated exposure.
Additional Information	: Exposure to very high concentrations of similar materials has been associated with irregular heart rhythms and cardiac arrest.

SECTION 12. ECOLOGICAL INFORMATION

Basis for Assessment	: Incomplete ecotoxicological data are available for this product. The information given below is based partly on a knowledge of the components and the ecotoxicology of similar products. Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).
12.1 Toxicity	
Acute Toxicity	: Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l (to aquatic organisms) LL/EL/IL50 expressed as the nominal amount of product required to prepare aqueous test extract.
Fish	: Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l
Aquatic crustacea	: Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l
Algae/aquatic plants	: Expected to be toxic: LL/EL/IL50 > 1 <= 10 mg/l
Microorganisms	: Expected to be harmful: LL/EL/IL50 >10 <= 100 mg/l
Chronic Toxicity	
Fish	: NOEC/NOEL expected to be > 1.0 - <= 10 mg/l
Aquatic crustacea	: NOEC/NOEL expected to be > 1.0 - <= 10 mg/l
12.2 Persistence and degradability	: Expected to be inherently biodegradable. Oxidises rapidly by photo-chemical reactions in air.
12.3 Bioaccumulative Potential	: Contains constituents with the potential to bioaccumulate. Log Kow > =4
12.4 Mobility in Soil	: Evaporates within a day from water or soil surfaces. Large volumes may penetrate soil and could contaminate groundwater. Toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment. Ether oxygenates

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are significantly more water soluble and less biodegradable than benzene, toluene, ethyl benzene and xylenes (BTEX). Consequently ether oxygenates have the potential to migrate relatively longer distances than BTEX in groundwater. Contains volatile components. Floats on water.

12.5 Result of PBT and vPvB assesment : The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.

SECTION 13. DISPOSAL CONSIDERATIONS

13.1 Waste Treatment Methods

Material Disposal : Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand. Do not dispose into the environment, in drains or in water courses. Do not dispose of tank water bottoms by allowing them to drain into the ground. This will result in soil and groundwater contamination.

Container Disposal : Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard. Do not puncture, cut, or weld uncleaned drums. Send to drum recoverer or metal reclaimer. Do not pollute the soil, water or environment with the waste container.

Local Legislation : Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be in compliance.
EU Waste Disposal Code (EWC): 13 07 03 wastes of liquid fuels, other fuels (including mixtures). The number given to waste is associated with the appropriate usage. The user must decide if their particular use results in another waste code being assigned.

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SECTION 14. TRANSPORT INFORMATION

Land transport (ADR/RID):

ADR

14.1 UN number : 1268
14.2 UN proper shipping name : PETROLEUM DISTILLATES, N.O.S.
14.3 Transport hazard class(es) : 3
14.4 Packing group : II
Danger label (primary risk) : 3
14.5 Environmental hazards : Yes
14.6 Special precautions for user : Special Precautions: Refer to Chapter 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

RID

14.1 UN number : 1268
14.2 UN proper shipping name : PETROLEUM DISTILLATES, N.O.S.
14.3 Transport hazard class(es) : 3
14.4 Packing group : II
Danger label (primary risk) : 3
14.5 Environmental hazards : Yes
14.6 Special precautions for user : Special Precautions: Refer to Chapter 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

Inland waterways transport (ADN):

14.1 UN number : 1268
14.2 UN proper shipping name : PETROLEUM DISTILLATES, N.O.S. (Naphtha, vp50 < 110 kPa)
14.3 Transport hazard class(es) : 3
14.4 Packing group : II
Danger label (primary risk) : 3
Danger label (subsidiary risk) : N2
F
14.5 Environmental : Yes

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hazards

14.6 Special precautions for user : Special Precautions: Refer to Chapter 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

CDNI Inland Water Waste Agreement : NST 3212 Naphtha.

Sea transport (IMDG Code):

14.1 UN number : UN 1268

14.2 UN proper shipping name : PETROLEUM DISTILLATES, N.O.S.

14.3 Transport hazard class(es) : 3

14.4 Packing group : II

14.5 Environmental hazards : Yes. Marine Pollutant

14.6 Special precautions for user : Special Precautions: Refer to Chapter 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

Air transport (IATA):

14.1 UN number : 1268

14.2 UN proper shipping name : Petroleum distillates, n.o.s.

14.3 Transport hazard class(es) : 3

14.4 Packing group : II

14.6 Special precautions for user : Special Precautions: Refer to Chapter 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution Category : Not applicable.

Ship Type : Not applicable.

Product Name : Not applicable.

Special Precaution : Not applicable.

Additional Information : MARPOL Annex 1 rules apply for bulk shipments by sea.

SECTION 15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

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15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Other regulatory Information

Recommended Restrictions on Use (Advice Against) : This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.

15.2 Chemical Safety Assessment : A Chemical Safety Assessment was performed for this substance.

SECTION 16. OTHER INFORMATION

R-phrases(s)

R11 Highly flammable.
R38 Irritating to skin.
R51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R65 Harmful: may cause lung damage if swallowed.
R67 Vapours may cause drowsiness and dizziness.

CLP Hazard Statements

H225 Highly flammable liquid and vapour.
H304 May be fatal if swallowed and enters airways.
H315 Causes skin irritation.
H336 May cause drowsiness or dizziness.
H411 Toxic to aquatic life with long lasting effects.

Identified Uses according to the Use Descriptor System

Uses - Worker

Title : Manufacture of substance- Industrial

Uses - Worker

Title : Use as an intermediate- Industrial

Uses - Worker

Title : Distribution of substance- Industrial

Uses - Worker

Title : Formulation & (re)packing of substances and mixtures-

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Industrial

Uses - Worker

Title : Use as a fuel- Industrial

Uses - Worker

Title : Use as a fuel- Professional

Identified Uses according to the Use Descriptor System

Uses - Consumer

Title : Use as a fuel
- Consumer

Additional Information : This document contains important information to ensure the safe storage, handling and use of this product. The information in this document should be brought to the attention of the person in your organisation responsible for advising on safety matters.

Other Information

Further Information : This product is intended for use in closed systems only.

The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.

Abbreviations and Acronyms

: The standard abbreviations and acronyms used in this document can be looked up in reference literature (e.g. scientific dictionaries) and/or websites.
Flam. Liq. = Flammable liquids
Skin Corr. = Skin corrosion/irritation
Asp. Tox. = Aspiration hazard
STOT SE = Specific target organ toxicity - single exposure

ACGIH = American Conference of Governmental Industrial Hygienists
ADR = European Agreement concerning the International Carriage of Dangerous Goods by Road
AICS = Australian Inventory of Chemical Substances
ASTM = American Society for Testing and Materials
BEL = Biological exposure limits
BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
CAS = Chemical Abstracts Service

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CEFIC = European Chemical Industry Council
CLP = Classification Packaging and Labelling
COC = Cleveland Open-Cup
DIN = Deutsches Institut für Normung
DMEL = Derived Minimal Effect Level
DNEL = Derived No Effect Level
DSL = Canada Domestic Substance List
EC = European Commission
EC50 = Effective Concentration fifty
ECETOC = European Center on Ecotoxicology and Toxicology
Of Chemicals
ECHA = European Chemicals Agency
EINECS = The European Inventory of Existing Commercial
Chemical Substances
EL50 = Effective Loading fifty
ENCS = Japanese Existing and New Chemical Substances
Inventory
EWC = European Waste Code
GHS = Globally Harmonised System of Classification and
Labelling of Chemicals
IARC = International Agency for Research on Cancer
IATA = International Air Transport Association
IC50 = Inhibitory Concentration fifty
IL50 = Inhibitory Level fifty
IMDG = International Maritime Dangerous Goods
INV = Chinese Chemicals Inventory
IP346 = Institute of Petroleum test method N° 346 for the
determination of polycyclic aromatics DMSO-extractables
KECI = Korea Existing Chemicals Inventory
LC50 = Lethal Concentration fifty
LD50 = Lethal Dose fifty per cent.
LL/EL/IL = Lethal Loading/Effective Loading/Inhibitory loading
LL50 = Lethal Loading fifty
MARPOL = International Convention for the Prevention of
Pollution From Ships
NOEC/NOEL = No Observed Effect Concentration / No
Observed Effect Level
OE_HP V = Occupational Exposure - High Production Volume
PBT = Persistent, Bioaccumulative and Toxic
PICCS = Philippine Inventory of Chemicals and Chemical
Substances
PNEC = Predicted No Effect Concentration
REACH = Registration Evaluation And Authorisation Of
Chemicals

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RID = Regulations Relating to International Carriage of
Dangerous Goods by Rail

SKIN_DES = Skin Designation

STEL = Short term exposure limit

TRA = Targeted Risk Assessment

TSCA = US Toxic Substances Control Act

TWA = Time-Weighted Average

vPvB = very Persistent and very Bioaccumulative

- Key literature references and sources for data** : The quoted data are from, but not limited to, one or more sources of information (e.g. toxicological data from Shell Health Services, material suppliers' data, CONCAWE, EU IUCLID date base, EC 1272 regulation, etc).
- SDS Distribution** : The information in this document should be made available to all who may handle the product.
- SDS Version Number** : 2.1
- SDS Effective Date** : 28.01.2014
- SDS Revisions** : A vertical bar (|) in the left margin indicates an amendment from the previous version.
- SDS Regulation** : Regulation 1907/2006/EC as amended by Regulation (EU) 453/2010
- Disclaimer** : This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

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Exposure Scenario - Worker

LBP Naphtha (< 0.1%Benzene)	
SECTION 1	EXPOSURE SCENARIO TITLE
Title	Manufacture of substance - Industrial
Use Descriptor	Sector of Use: SU 3, SU8, SU9 Process Categories: PROC 1, PROC 2, PROC 3, PROC 4, PROC 8a, PROC 8b, PROC 15 Environmental Release Categories: ERC 1, ERC 4, ESVOC SpERC 1.1.v1
Scope of process	Manufacture of the substance or use as a process chemical or extraction agent. Includes recycling/ recovery, material transfers, storage, maintenance and loading (including marine vessel/barge, road/rail car and bulk container), sampling and associated laboratory activities.

SECTION 2	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES

Section 2.1	Control of Worker Exposure
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of substance in product.	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Operation is carried out at elevated temperature (> 20°C above ambient temperature). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	Risk Management Measures
General measures (skin irritants).	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.

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General exposures (closed systems).	No other specific measures identified.
General exposures (closed systems).with sample collection.	No other specific measures identified.
General exposures (open systems).	Provide extract ventilation to points where emissions occur.
Mixing operations (closed systems).	No other specific measures identified.
Process sampling.	No other specific measures identified.
Laboratory activities.	Handle in a fume cupboard or under extract ventilation.
Bulk transfers.	No other specific measures identified.
Drum/batch transfers.	No other specific measures identified.
Equipment maintenance.	No other specific measures identified.
Storage.	No other specific measures identified.

Section 2.2	Control of Environmental Exposure
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0,1
Regional use tonnage (tonnes/year):	1,87E+07
Fraction of Regional tonnage used locally:	0,032
Annual site tonnage (tonnes/year):	6,0E+05
Maximum daily site tonnage (kg/day):	2,0E+06
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	0,05
Release fraction to wastewater from process (initial release prior to RMM):	3,0E-03
Release fraction to soil from process (initial release prior to RMM):	1,0E-04

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Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
Onsite waste water treatment required.	
Treat air emission to provide a typical removal efficiency of (%)	99,0
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	99,1
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	80,4
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	95,5
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	99,1
Maximum allowable site tonnage (MSafe) (kg/d):	2,0E+06
Assumed domestic sewage treatment plant flow (m3/d)	10.000
Conditions and Measures related to external treatment of waste for disposal	
During manufacturing no waste of the substance is generated.	
Conditions and measures related to external recovery of waste	
During manufacturing no waste of the substance is generated.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

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SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation.	
Section 4.2 -Environment	
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.	
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.	
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.	
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org).	

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Exposure Scenario - Worker

LBP Naphtha (< 0.1% Benzene)	
SECTION 1	EXPOSURE SCENARIO TITLE
Title	Use as an intermediate - Industrial
Use Descriptor	Sector of Use: SU 3, SU8, SU9 Process Categories: PROC 1, PROC 2, PROC 3, PROC 4, PROC 8a, PROC 8b, PROC 15 Environmental Release Categories: ERC 6A, ESVOC SpERC 6.1a.v1
Scope of process	Use of substance as an intermediate (not related to Strictly Controlled Conditions). Includes recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).

SECTION 2	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES

Section 2.1	Control of Worker Exposure
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of substance in product.	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Operation is carried out at elevated temperature (> 20°C above ambient temperature). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	Risk Management Measures
General measures (skin irritants).	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.

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General exposures (closed systems).	No other specific measures identified.
General exposures (closed systems).with sample collection.	No other specific measures identified.
General exposures (open systems).	Provide extract ventilation to points where emissions occur.
Mixing operations (closed systems).	No other specific measures identified.
Process sampling.	No other specific measures identified.
Laboratory activities.	Handle in a fume cupboard or under extract ventilation.
Bulk transfers.	No other specific measures identified.
Drum/batch transfers.	No other specific measures identified.
Equipment maintenance.	No other specific measures identified.
Storage.	No other specific measures identified.

Section 2.2	Control of Environmental Exposure
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0,1
Regional use tonnage (tonnes/year):	2,21E+06
Fraction of Regional tonnage used locally:	0,0068
Annual site tonnage (tonnes/year):	1,5E+04
Maximum daily site tonnage (kg/day):	5,0E+04
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	0,025
Release fraction to wastewater from process (initial release prior to RMM):	3,0E-03
Release fraction to soil from process (initial release prior to RMM):	1,0E-03

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Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Risk from environmental exposure is driven by freshwater sediment.	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Treat air emission to provide a typical removal efficiency of (%)	80
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	92,9
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	95,5
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	95,5
Maximum allowable site tonnage (MSafe) (kg/d):	7,8E+04
Assumed domestic sewage treatment plant flow (m3/d)	2.000
Conditions and Measures related to external treatment of waste for disposal	
This substance is consumed during use and no waste of substance is generated.	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of substance is generated.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

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SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation.	
Section 4.2 -Environment	
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.	
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.	
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.	
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org).	

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Exposure Scenario - Worker

LBP Naphtha (< 0.1% Benzene)	
SECTION 1	EXPOSURE SCENARIO TITLE
Title	Distribution of substance - Industrial
Use Descriptor	Sector of Use: SU 3 Process Categories: PROC 1, PROC 2, PROC 3, PROC 4, PROC 8a, PROC 8b, PROC 9, PROC 15 Environmental Release Categories: ERC 1, ERC 2, ERC 3, ERC 4, ERC 5, ERC 6A, ERC 6B, ERC 6C, ERC 6D, ERC 7, ESVOC SpERC 1.1b.v1
Scope of process	Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading distribution and associated laboratory activities.

SECTION 2	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES

Section 2.1	Control of Worker Exposure
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of substance in product.	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	Risk Management Measures
General measures (skin irritants).	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.

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General exposures (closed systems).	No other specific measures identified.
General exposures (closed systems).with sample collection.	No other specific measures identified.
General exposures (open systems).	Provide extract ventilation to points where emissions occur.
Process sampling.	No other specific measures identified.
Laboratory activities.	Handle in a fume cupboard or under extract ventilation.
Bulk closed loading and unloading.	No other specific measures identified.
Drum and small package filling.	Fill containers/cans at dedicated fill points supplied with local extract ventilation.
Equipment cleaning and maintenance.	No other specific measures identified.
Storage.	No other specific measures identified.

Section 2.2	Control of Environmental Exposure
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0,1
Regional use tonnage (tonnes/year):	1,87E+07
Fraction of Regional tonnage used locally:	0,002
Annual site tonnage (tonnes/year):	3,75E+04
Maximum daily site tonnage (kg/day):	1,2E+05
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	100
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	1,0E-03
Release fraction to wastewater from process (initial release prior to RMM):	1,0E-05
Release fraction to soil from process (initial release prior to RMM):	1,0E-05
Technical conditions and measures at process level (source) to prevent release	

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Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Treat air emission to provide a typical removal efficiency of (%)	90
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%)	12
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	95,5
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	95,5
Maximum allowable site tonnage (MSafe) (kg/d):	1,1E+06
Assumed domestic sewage treatment plant flow (m3/d)	2.000
Conditions and Measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable local and/or regional regulations.	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable local and/or regional regulations.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

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SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation.	
Section 4.2 -Environment	
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.	
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.	
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.	
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org).	

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Exposure Scenario - Worker

LBP Naphtha (< 0.1%Benzene)	
SECTION 1	EXPOSURE SCENARIO TITLE
Title	Formulation & (re)packing of substances and mixtures - Industrial
Use Descriptor	Sector of Use: SU 3, SU 10 Process Categories: PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 8a, PROC 8b, PROC 9, PROC 14, PROC 15 Environmental Release Categories: ERC 2, ESVOC SpERC 2.2.v1
Scope of process	Formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, tableting, compression, pelletisation, extrusion, large and small scale packing, sampling, maintenance and associated laboratory activities.

SECTION 2	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES

Section 2.1	Control of Worker Exposure
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of substance in product.	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	Risk Management Measures
General measures (skin irritants).	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin

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	problems that may develop.
General exposures (closed systems).	No other specific measures identified.
General exposures (closed systems).with sample collection.	No other specific measures identified.
General exposures (open systems).	Provide extract ventilation to points where emissions occur.
Process sampling.	No other specific measures identified.
Mixing operations (closed systems).	Provide extract ventilation to points where emissions occur.
Laboratory activities.	Handle in a fume cupboard or under extract ventilation.
Bulk transfers.	Ensure material transfers are under containment or extract ventilation.
Manual.Transfer from/pouring from containers.	Ensure material transfers are under containment or extract ventilation.
Drum/batch transfers.	Ensure material transfers are under containment or extract ventilation.
Drum and small package filling.	Fill containers/cans at dedicated fill points supplied with local extract ventilation.
Equipment cleaning and maintenance.	No specific measures identified.
Storage.	No other specific measures identified.

Section 2.2	Control of Environmental Exposure
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0,1
Regional use tonnage (tonnes/year):	1,65E+07
Fraction of Regional tonnage used locally:	0,0018
Annual site tonnage (tonnes/year):	3,0E+04
Maximum daily site tonnage (kg/day):	1,0E+05
Frequency and Duration of Use	
Continuous release.	

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Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	0,025
Release fraction to wastewater from process (initial release prior to RMM):	2,0E-03
Release fraction to soil from process (initial release prior to RMM):	1,0E-04
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Treat air emission to provide a typical removal efficiency of (%)	56,5
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	94,7
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	95,5
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	95,5
Maximum allowable site tonnage (MSafe) (kg/d):	1,0E+05
Assumed domestic sewage treatment plant flow (m3/d)	2.000
Conditions and Measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable local and/or regional regulations.	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable local and/or regional regulations.	

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SECTION 3	EXPOSURE ESTIMATION

Section 3.1 - Health

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 3.2 - Environment

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO

Section 4.1 - Health

Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented.
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Risk Management Measures are based on qualitative risk characterisation.

Section 4.2 -Environment

Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.

Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.

Further details on scaling and control technologies are provided in SpERC factsheet (<http://cefic.org>).

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Exposure Scenario - Worker

LBP Naphtha (< 0.1%Benzene)	
SECTION 1	EXPOSURE SCENARIO TITLE
Title	Use as a fuel - Industrial
Use Descriptor	Sector of Use: SU 3 Process Categories: PROC 1, PROC 2, PROC 3, PROC 8a, PROC 8b, PROC 16 Environmental Release Categories: ERC 7, ESVOC SpERC 7.12a.v1
Scope of process	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.

SECTION 2	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES

Section 2.1	Control of Worker Exposure
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of substance in product.	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	Risk Management Measures
General measures (skin irritants).	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.
General exposures (closed)	No specific measures identified.

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systems).	
Bulk closed unloading.	No specific measures identified.
Drum/batch transfers.	No specific measures identified.
Refueling.	No specific measures identified.
Refuelling aircraft.	Ensure material transfers are under containment or extract ventilation.
Use as a fuel(closed systems).	No specific measures identified.
Equipment maintenance.	No other specific measures identified.
Storage.	No specific measures identified.

Section 2.2	Control of Environmental Exposure
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0,1
Regional use tonnage (tonnes/year):	1,4E+06
Fraction of Regional tonnage used locally:	1
Annual site tonnage (tonnes/year):	1,4E+06
Maximum daily site tonnage (kg/day):	4,6E+06
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	2,5E-03
Release fraction to wastewater from process (initial release prior to RMM):	1,0E-05
Release fraction to soil from process (initial release prior to RMM):	0
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect	

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exposure (primarily inhalation).	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Treat air emission to provide a typical removal efficiency of (%)	99,4
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	76,9
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	95,5
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	95,5
Maximum allowable site tonnage (MSafe) (kg/d):	4,6E+06
Assumed domestic sewage treatment plant flow (m3/d)	2.000
Conditions and Measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls. Waste combustion emissions considered in regional exposure assessment.	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of substance is generated.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.	

SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented.	

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Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Risk Management Measures are based on qualitative risk characterisation.

Section 4.2 -Environment

Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.

Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.

Further details on scaling and control technologies are provided in SpERC factsheet (<http://cefic.org>).

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Exposure Scenario - Worker

LBP Naphtha (< 0.1%Benzene)	
SECTION 1	EXPOSURE SCENARIO TITLE
Title	Use as a fuel - Professional
Use Descriptor	Sector of Use: SU 22 Process Categories: PROC 1, PROC 2, PROC 3, PROC 8a, PROC 8b, PROC 16 Environmental Release Categories: ERC 9A, ERC 9B, ESVOC SpERC 9.12b.v1
Scope of process	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.

SECTION 2	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES

Section 2.1	Control of Worker Exposure
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of substance in product.	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	Risk Management Measures
General measures (skin irritants).	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.
General exposures (closed	No other specific measures identified.

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systems).	
Preparation of material for application.Mixing operations (closed systems).	No other specific measures identified.
Bulk closed unloading.	No other specific measures identified.
Drum/batch transfers.	No other specific measures identified.
Refueling.	No other specific measures identified.
Use as a fuel(closed systems).	No other specific measures identified.
Equipment maintenance.	Drain down system prior to equipment break-in or maintenance. Wear chemically resistant gloves (tested to EN374) in combination with intensive management supervision controls.
Storage.	No other specific measures identified.

Section 2.2	Control of Environmental Exposure
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0,1
Regional use tonnage (tonnes/year):	1,19E+06
Fraction of Regional tonnage used locally:	5,0E-04
Annual site tonnage (tonnes/year):	5,9E+02
Maximum daily site tonnage (kg/day):	1,6E+03
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	365
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	0,01
Release fraction to wastewater from process (initial release prior to RMM):	1,0E-05
Release fraction to soil from process (initial release prior to RMM):	1,0E-05
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process	

Safety Data Sheet

release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Treat air emission to provide a typical removal efficiency of (%)	
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	3,4
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	95,5
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	95,5
Maximum allowable site tonnage (MSafe) (kg/d):	1,5E+04
Assumed domestic sewage treatment plant flow (m3/d)	2.000
Conditions and Measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls. Waste combustion emissions considered in regional exposure assessment.	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of substance is generated.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.	

SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE

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EXPOSURE SCENARIO	
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation.	
Section 4.2 -Environment	
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.	
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.	
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.	
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org).	

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Exposure Scenario - Consumer

LBP Naphtha (< 0.1%Benzene)	
SECTION 1	EXPOSURE SCENARIO TITLE
Title	Use as a fuel - Consumer
Use Descriptor	Sector of Use: SU 21 Product Categories: PC13 Environmental Release Categories: ERC 9A, ERC 9B, ESVOC SpERC 9.12c.v1
Scope of process	Covers consumer uses in liquid fuels.

SECTION 2	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES

Section 2.1	Control of Consumer Exposure
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 Pa at STP
Concentration of substance in product.	Unless otherwise stated:
	Covers concentrations up to 100 %
Amounts Used	
Unless otherwise stated:	
for each use event, covers amount up to (g):	37.500
covers skin contact area (cm2):	420
Frequency and Duration of Use	
Unless otherwise stated:	
covers use up to (times/day of use):	0,143
Covers use up to (hours/event):	2
Other Operational Conditions affecting Exposure	
Unless otherwise stated:	
Covers use at ambient temperatures.	
Covers use in room size of 20m3.	
Covers use under typical household ventilation.	

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Product Categories	OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES
Fuels. Liquid: Automotive Refuelling.	Covers concentrations up to 100 %
	covers use up to 52 day/year
	Covers use up to 1 times/day of use
	covers skin contact area up to 210 cm ²
	For each use event, covers amount up to 37.500 g.
	Covers outdoor use.
	Covers use in room size of 100 m ³
	Covers exposure up to 0,05 hours/event
Fuels. Liquid Scooter Refuelling.	Covers concentrations up to 100 %
	covers use up to 52 day/year
	Covers use up to 1 times/day of use
	covers skin contact area up to 210 cm ²
	For each use event, covers amount up to 3.750 g.
	Covers outdoor use.
	Covers use in room size of 100 m ³
	Covers exposure up to 0,03 hours/event
Fuels. Liquid, Garden Equipment - Use.	Covers concentrations up to 100 %
	covers use up to 26 day/year
	Covers use up to 1 times/day of use
	For each use event, covers amount up to 750 g.
	Covers outdoor use.
	Covers use in room size of 100 m ³
	Covers exposure up to 2,00 hours/event
Fuels. Liquid: Garden Equipment - Refuelling.	Covers concentrations up to 100 %
	covers use up to 26 day/year
	Covers use up to 1 times/day of use
	covers skin contact area up to 420 cm ²
	For each use event, covers amount up to 750 g.
	Covers use in a one car garage (34 m ³) under typical ventilation.
	Covers use in room size of 34 m ³
	Covers exposure up to 0,03 hours/event

Section 2.2	Control of Environmental Exposure
Substance is complex UVCB.	
Predominantly hydrophobic.	

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Amounts Used	
Fraction of EU tonnage used in region:	0,1
Regional use tonnage (tonnes/year):	1,39E+07
Fraction of Regional tonnage used locally:	5,0E-04
Annual site tonnage (tonnes/year):	7,0E+03
Maximum daily site tonnage (kg/day):	1,9E+04
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	365
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	0,01
Release fraction to wastewater from process (initial release prior to RMM):	1,0E-05
Release fraction to soil from process (initial release prior to RMM):	1,0E-05
Conditions and Measures related to municipal sewage treatment plant	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
Estimated substance removal from wastewater via domestic sewage treatment (%)	95,5
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d)	1,8E+05
Assumed domestic sewage treatment plant flow (m3/d)	2.000
Conditions and Measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls. Waste combustion emissions considered in regional exposure assessment.	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of substance is generated.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate consumer exposures unless otherwise indicated.	
Section 3.2 - Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.	

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SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the applicable consumer reference values when the operational conditions/risk management measures given in section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.	
Section 4.2 -Environment	
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org).	



MATERIAL SAFETY DATA SHEET

Sulfur

MSDS No. 1794

EMERGENCY OVERVIEW

DANGER!

**FLAMMABLE SOLID - BURNING SULFUR EMITS TOXIC AND SUFFOCATING
SULFUR DIOXIDE - MOLTEN SULFUR MAY EVOLVE TOXIC AND
FLAMMABLE HYDROGEN SULFIDE GAS -**



NFPA 704 (Section 16)

MOLTEN SULFUR CAN CAUSE THERMAL BURNS

Solid and molten sulfur can be ignited; burning sulfur produces sulfur dioxide, an irritating, toxic, and suffocating gas.

Dust particles may be irritating to the eyes, nose, throat, and skin. Molten sulfur can cause thermal burns.

Molten sulfur may evolve HYDROGEN SULFIDE (toxic gas) which may accumulate in storage container vapor space. High concentration may cause immediate unconsciousness - death may result unless victim is promptly and successfully resuscitated. Hydrogen sulfide causes eye irritation.

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

HOVENSA LLC

1 Estate Hope

Christiansted, VI 00820-5652

EMERGENCY TELEPHONE NUMBER (24 hrs):

COMPANY CONTACT (business hours):

CHEMTREC (800)424-9300

(340) 692-3000

SYNONYMS: Brimstone; Sulphur

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and CHEMICAL INFORMATION ON INGREDIENTS

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Sulfur (7704-34-9)	100
Hydrogen Sulfide (7783-06-4)	< trace - see below >

Hydrogen Sulfide (H₂S) may be present in trace quantities (by weight) in molten sulfur but may accumulate to toxic or flammable concentrations in enclosed spaces such as molten sulfur storage pits, tanks, or tanker/railcar headspaces. H₂S is not considered a hazard associated with solid sulfur.

3. HAZARDS IDENTIFICATION

EYES

Contact with molten sulfur may cause serious burns and blindness. Sulfur vapor may cause eye irritation. Dust contact with eyes may cause mechanical irritation (abrasion), characterized by a scratchy discomfort. This may progress to burning and tearing, with blurring of vision upon repeated or prolonged exposure. These symptoms are generally reversible once exposure is discontinued. Excessive exposure may cause more severe symptoms such as redness, pain, sensitivity to light, and conjunctivitis. Some severe exposure cases have resulted in permanent damage.

Exposure to approximately 8 ppm sulfur vapor has been shown to cause eye irritation.



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SKIN

Prolonged contact with sulfur dust in a localized area may result in irritation, primarily from abrasive action. Molten sulfur may cause 1st, 2nd, or 3rd degree thermal burns.

INGESTION

Ingestion of small amounts of solid sulfur should not cause significant health effects. Large doses can produce mucous membrane irritation, difficult swallowing, redness of the throat and tongue, stomach, and urinary disturbances. Vomiting, abdominal pain and diarrhea may also occur. Long-term ingestion of small amounts may have a laxative effect. Ingestion of very large amounts may cause sore throat, nausea, headache, and possibly unconsciousness in severe cases. May be converted into hydrogen sulfide in the intestine.

INHALATION

Inhalation of low concentrations of dust should not cause significant health effects. Inhalation of large amounts of dust may cause inflammation of the nose and throat, resulting in secretions from the nose. Symptoms include sore throat, tightness of the chest, chest pain, lightheadedness, and persistent cough with sputum.

WARNING: Irritating and toxic hydrogen sulfide gas may be found in confined vapor spaces. Greater than 15 - 20 ppm continuous exposure can cause mucous membrane and respiratory tract irritation. 50 - 500 ppm can cause headache, nausea, and dizziness, loss of reasoning and balance, difficulty in breathing, fluid in the lungs, and possible loss of consciousness. Greater than 500 ppm can cause rapid or immediate unconsciousness due to respiratory paralysis and death by suffocation unless the victim is removed from exposure and successfully resuscitated.

The "rotten egg" odor of hydrogen sulfide is not a reliable indicator for warning of exposure, since olfactory fatigue (loss of smell) readily occurs, especially at concentrations above 50 ppm. At high concentrations, the victim may not even recognize the odor before becoming unconscious.

CHRONIC

Long-term exposure to high concentrations can cause respiratory disease - see Section 11, Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Exposure may aggravate preexisting bronchitis, asthma, and open wounds, skin disorders, and dermatitis (rash).

4. FIRST AID MEASURES

EYES

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and the area of the body burned.

INGESTION

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION

Remove person to fresh air. If person is not breathing provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.



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5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT: 405 °F (207 °C)
AUTOIGNITION TEMPERATURE: 450 °F (232 °C)
LOWER EXPLOSIVE LIMIT (%): 35 gm/m³ (dust); 4% for hydrogen sulfide
UPPER EXPLOSIVE LIMIT (%): 1,400 gm/m³ (dust); 44% for hydrogen sulfide

FIRE AND EXPLOSION HAZARDS

Reference NFPA 655 "Prevention of Sulfur Fires and Explosions," 1993.

Flammable solid with a relatively low ignition temperature. Sulfur dust ignites easily in air. Grinding sulfur may produce an explosion hazard. Static discharge may ignite sulfur dust.

Sulfur burns with a pale blue flame that may be difficult to see in daylight. Burning sulfur will flow and emits large quantities of sulfur dioxide (SO₂), a toxic, irritating, and suffocating gas that can cause severe lung damage and death.

Molten sulfur may evolve hydrogen sulfide (H₂S) - H₂S is a flammable gas and may present an explosion hazard in a confined space. Under certain conditions, H₂S can react to form pyrophoric iron compounds in enclosed spaces such as sulfur pits.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO₂, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Product may release substantial amounts of flammable vapors and gases (e.g., methane, ethane, and propane), at or below ambient temperature depending on source and process conditions and pressure.



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Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection - do not discharge solid water stream patterns into the liquid resulting in splashing.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE

HANDLING and STORAGE PRECAUTIONS

Store solid sulfur in a well ventilated area away from incompatible materials. The hazards of hydrogen sulfide should be considered when storing or transporting molten sulfur. H₂S can accumulate in confined spaces such as sulfur pits and headspaces of truck trailers and railcars. Exposure to H₂S is possible during product transfer into/out of truck trailers and railcars.

Use appropriate engineering controls or respiratory protection. Sulfur pits should be vented away from possible worker exposure areas.

Prohibit smoking in storage and work areas. Electrical installations and equipment in hazardous locations should be installed according to articles 501 and 502 of the National Electric Code. Reference also NFPA 655 Standard for the Prevention of Sulfur Fires and Explosions.

WORK/HYGIENIC PRACTICES

Protect against hot liquid. Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use gasoline or solvents (naphtha, kerosene, etc.) for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION

EXPOSURE LIMITS

Components (CAS No.)	Source	Exposure Limits		Note
		TWA/STEL		
Sulfur (17704-34-9)	OSHA ACGIH	PEL = None established TLV = None established		
Hydrogen Sulfide (H ₂ S) (7783-06-4)	OSHA ACGIH	PEL = 20ppm; STEL = 50 ppm TLV = 10 ppm; STEL = 15 ppm		2006 NOIC 1/5 ppm

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor, hydrogen sulfide and dust concentrations of this product below occupational exposure limits and flammability limits, particularly in confined spaces. Use explosion-proof equipment and lighting in classified/controlled areas.

EYE/FACE PROTECTION

Safety goggles are recommended for excessive dust exposure. Use faceshield for protection against molten sulfur.



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SKIN PROTECTION

Avoid repeated or prolonged skin contact. For protection from molten sulfur, gloves and skin protection constructed of leather or heat resistant materials are recommended.

RESPIRATORY PROTECTION

If a hydrogen sulfide hazard is present (that is, exposure potential above H₂S permissible exposure limit), use a positive-pressure SCBA or Type C supplied air respirator with escape bottle.

Dust protection: where it has been determined that there is no hydrogen sulfide exposure hazard (that is, exposure potential below H₂S permissible exposure limit), a NIOSH/ MSHA-approved air-purifying respirator with dust cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES

APPEARANCE

Yellow solid in block or pellet for; easily crushed into yellow dust. Hot, yellow liquid

ODOR

Pure sulfur is odorless and tasteless. However, trace hydrocarbon impurities may give it a faint oily and/or rotten egg odor.

Hydrogen sulfide (H₂S) has a rotten egg "sulfurous" odor. This odor should not be used as a warning property of toxic levels because H₂S can overwhelm and deaden the sense of smell. Also, the odor of H₂S in heavy oils can easily be masked by the petroleum-like odor of the oil. Therefore, the smell of H₂S should not be used as an indicator of a hazardous condition - a H₂S meter or colorimetric indicating tubes are typically used to determine the concentration of H₂S.

BASIC PHYSICAL PROPERTIES

BOILING POINT:	832 °F (445 °C)
MELTING POINT:	235 to 248 °F (113 to 120 °C)
VAPOR PRESSURE:	4x10 ⁻⁶ mm Hg @ 86 °F (30 °C)
SPECIFIC GRAVITY (H ₂ O = 1):	AP 1.96 (varies)
PERCENT VOLATILES:	Negligible
SOLUBILITY:	Insoluble in water

10. STABILITY and REACTIVITY

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID and INCOMPATIBLE MATERIALS

Avoid high temperatures, open flames, welding, smoking and ignitions sources. Under certain conditions, H₂S can react to form pyrophoric iron compounds in enclosed spaces such as sulfur pits. Exposure of pyrophoric compounds to air or moisture can cause excessive heat generation, smoke and toxic gases, and fire.



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INCOMPATIBLE MATERIALS

Sulfur is incompatible with a number of chemical materials including, but not limited to, chlorates, nitrates, other oxidizers, carbides, halogens, phosphorus, and heavy metals. This incompatibility may result in fire, excessive heat generation, uncontrolled reaction, release of toxic products and/or explosion. A comprehensive list of incompatible materials may be found in the latest edition of Sax's "Dangerous Properties of Industrial Materials" and the NFPA "Hazardous Materials Guide".

HAZARDOUS DECOMPOSITION PRODUCTS:

Sulfur burns to sulfur dioxide. Sulfur reactions with hydrocarbons and other organic materials may produce hydrogen sulfide and carbon disulfide. Other possibly toxic reaction or decomposition products are highly dependent on the incompatible material.

11. TOXICOLOGICAL PROPERTIES

ACUTE TOXICITY

Large doses (15 grams) by mouth may lead to hydrogen sulfide production in the body, chiefly due to bacterial action within the colon.

Rat-oral LD50 = 175 mg/kg

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: **OSHA:** NO **IARC:** NO **NTP:** NO **ACGIH:** NO

Prolonged inhalation of dust over several years (as demonstrated in miners) may cause respiratory disease, complicated by emphysema and bronchiectasis. Asthma and inflammation of the frontal and maxillary sinuses are frequent complications. Pulmonary function may be reduced showing increased oxygen consumption, reduced respiratory volume, and impaired carbon dioxide diffusion capacity. Radiological examinations have revealed irregular opacities in the lungs and nodulation.

12. ECOLOGICAL INFORMATION

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION

	<u>DOMESTIC SHIPMENT</u>	<u>INTERNATIONAL SHIPMENT</u>
PROPER SHIPPING NAME:	SULFUR	SULFUR
HAZARD CLASS, PACKING GROUP:	9, PG III	4.1, PG III
DOT IDENTIFICATION NUMBER:	NA 1350	UN 1350
DOT SHIPPING LABEL:	CLASS 9	FLAMMABLE SOLID
PROPER SHIPPING NAME:	SULFUR, MOLTEN	SULFUR, MOLTEN
HAZARD CLASS, PACKING GROUP:	9, PG III	4.1, PG III
DOT IDENTIFICATION NUMBER:	NA 2448	UN 2448
DOT SHIPPING LABEL:	CLASS 9	FLAMMABLE SULFUR

15. REGULATORY INFORMATION

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other regulations at the state and/or local level. Consult those regulations applicable to your facility/operation.



MATERIAL SAFETY DATA SHEET

Sulfur

MSDS No. 1794

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

<u>ACUTE HEALTH</u>	<u>CHRONIC HEALTH</u>	<u>FIRE</u>	<u>SUDDEN RELEASE OF PRESSURE</u>	<u>REACTIVE</u>
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product does not contain any chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372.

CALIFORNIA PROPOSITION 65 LIST OF CHEMICALS

This product does not contain chemicals that are included on the Proposition 65 "List of Chemicals" required by the California Safe Drinking Water and Toxic Enforcement Act of 1986.

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 4 (Flammable Solid) and Class D, Div 1A (Very Toxic material - hydrogen sulfide)

<u>NFPA® HAZARD RATING</u>	HEALTH:	1
	FIRE:	1
	REACTIVITY:	0

Refer to NJPA 704 "Identification of the Fire Hazards of Materials" for further information

<u>HMIS® HAZARD RATING</u>	HEALTH:	1 *	Slight
	FIRE:	1	Moderate
	Physical:	0	Negligible
			* Chronic

SPECIAL HAZARDS: Toxic and flammable hydrogen sulfide (poison gas) may accumulate in the vapor space of molten sulfur storage container

SUPERSEDES MSDS DATED: 03/22/2000

ABBREVIATIONS:

AP = Approximately	< = Less than	> = Greater than
N/A = Not Applicable	N/D = Not Determined	ppm = parts per million



MATERIAL SAFETY DATA SHEET

Sulfur

MSDS No. 1794

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	NTP	National Toxicology Program
AIHA	American Industrial Hygiene Association	OPA	Oil Pollution Act of 1990
ANSI	American National Standards Institute (212) 642-4900	OSHA	U.S. Occupational Safety & Health Administration
API	American Petroleum Institute (202) 682-8000	PEL	Permissible Exposure Limit (OSHA)
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act	RCRA	Resource Conservation and Recovery Act
DOT	U.S. Department of Transportation [General info: (800) 467-4922]	REL	Recommended Exposure Limit (NIOSH)
EPA	U.S. Environmental Protection Agency	SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
HMIS	Hazardous Materials Information System	SCBA	Self-Contained Breathing Apparatus
IARC	International Agency For Research On Cancer	SPCC	Spill Prevention, Control, and Countermeasures
MSHA	Mine Safety and Health Administration	STEL	Short-Term Exposure Limit (generally 15 minutes)
NFPA	National Fire Protection Association (617)770-3000	TLV	Threshold Limit Value (ACGIH)
NIOSH	National Institute of Occupational Safety and Health	TSCA	Toxic Substances Control Act
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)	TWA	Time Weighted Average (8 hr.)
		WEEL	Workplace Environmental Exposure Level (AIHA)
		WHMIS	Canadian Workplace Hazardous Materials Information System

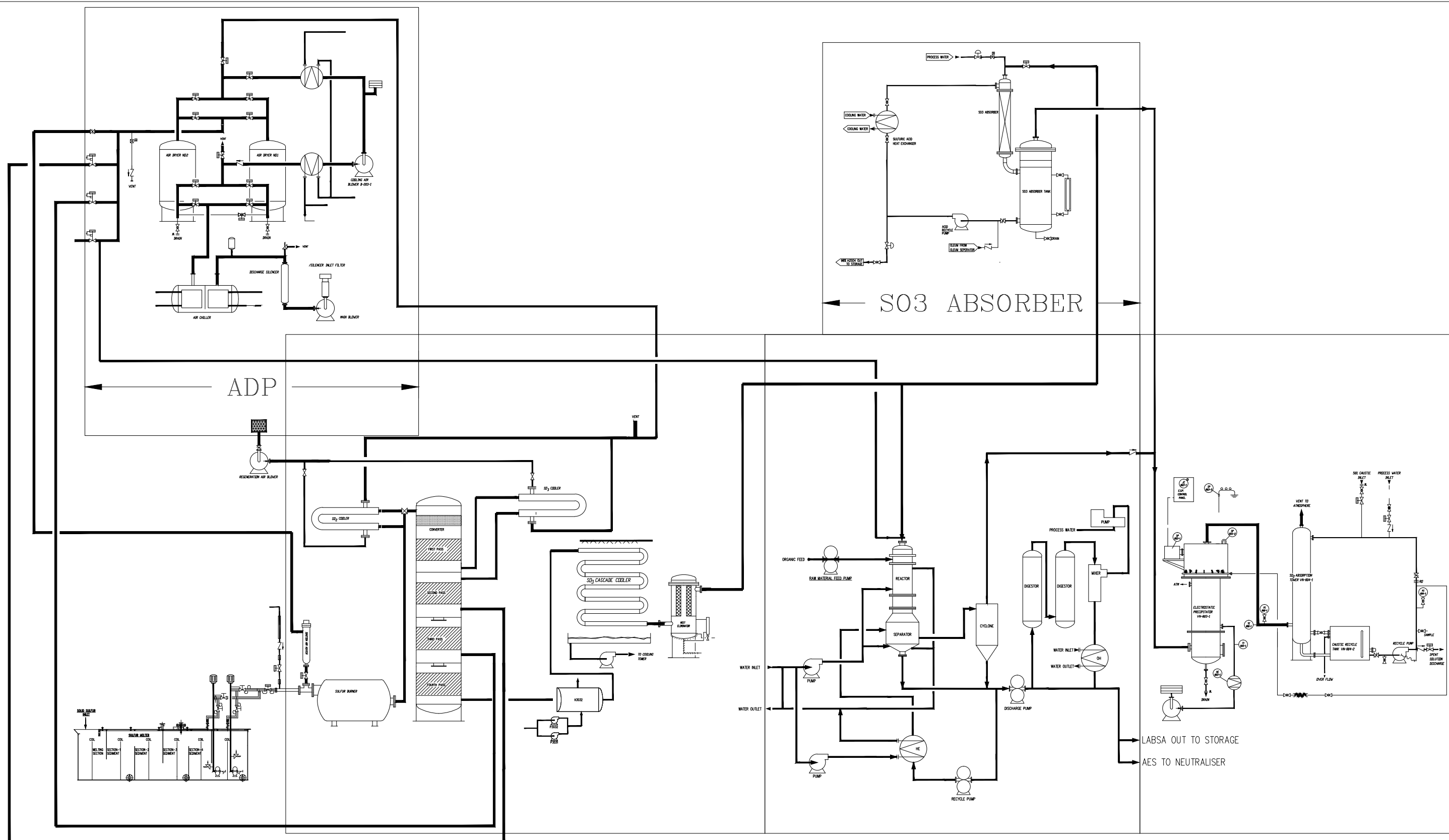
DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

ANNEXURE-XII

FLOW SHEET OF SULPHONATION PLANT



SULFONATION PLANT FOR AOS.

ANNEXURE-XIII

WATER APPROVAL LETTER

CASH BILL

Cell : 93454 51940
93457 06634

RAYAR TRANSPORT

**FLEET OWNERS, TRANSPORT CONTRACTORS
LORRY SUPPLIERS & WATER TANKER SUPPLIERS**

No. 13, Jai Nagar, Mailam Road,
Thiruchitrambalam, Vanur T.k., 605 111.

DRA. JAYARAJ

PROPRIETOR To,

Date :
02.01.2017

M/s Power Soaps Private Limited,

Sedrapet Industrial Area,

Puducherry

Sir,

We hereby confirm and give undertaking that we will supply water in our tanker lorry
as per the requirement of your company. However, at present it is stated that this
will be 30 to 35 KLD p/day as and when commissioning of plant takes place.

Thanking You,

For RAYAR TRANSPORT



Proprietor